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The Belt Book

Guide ng-Surface to different kinds of belts

Too much Cling-Surface at one time causes temporary slip or may even make a belt leave the pulleys under heavy load. The stain produced by Cling-Surface on the pulleys tells when enough has been applied, and a little experience in this regard will enable the user to judge correctly at sight. The stains indicated below should not be exceeded, and *new* belts should have even lighter treatment. More explicit directions for belts running under unusual conditions may be found by referring to the index, pages 3 and 91.

For leather (except chromes), plain unpainted canvas or cotton, camel hair and other porous belts, and ropes.

For painted cotton (Gandy, Leviathan, Teon, etc.) and other comparatively non-porous belts and for chrome and orange tanned leather.

For rubber and balata belts. The stain should be just visible on the pulley face. Also for any kind of belts in dusty surroundings. *(See page 48.)*

The Belt Book

A Treatise on the Scientific Care of Transmission Belts and Ropes for Service and Profit

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Price $1.00

FIFTH EDITION

Copyrighted 1914 by Cling-Surface Co

Completely rewritten by
A. EUGENE MICHEL, M.S.
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BUFFALO N Y U S A

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MOST literature on belts and belt management is based upon the old practice of running belts tight, which has been upset by the new practice, made possible by Cling-Surface treatment and now so common, of running belts slack.

This little book is therefore filled with simple information about the slack belt and about efficient everyday belt management, in the hope that the practical man will be stimulated to give the subject the serious attention which it deserves.

Our unique experience, through the sale of Cling-Surface during the past seventeen years direct to thousands of belt users all over the world, fits us peculiarly well to deal with belt problems. We believe we have given in this book more good hints on overcoming belt troubles and losses than can be found in any other publication.

The mere selling of Cling-Surface seems to us to be of even less importance than the securing by our customers of maximum benefits after purchase. It is therefore our wish and hope that all following references to Cling-Surface be carefully studied. We will gladly offer further advice upon application concerning any belt problems not treated in this book, or concerning any belt matters about which we have not made ourselves sufficiently clear. Inquiries, preferably accompanied by complete data, will receive prompt attention. Read our Guarantee on page 93 of this book.

Cling-Surface Co

The author hereby acknowledges his indebtedness to Mr. Robert Thurston Kent for numerous quotations from his series of articles on Scientific Belt Management, and to Power, The Practical Engineer, The National Engineer, Southern Engineer, American Machinist and Machinery for abstracts from various articles that have appeared in their columns.

The photographic illustrations in this book

are absolutely truthful. None has been "doctored" in the engraving process to misrepresent conditions.

All accompanying data, too, are based upon documentary evidence in our office and subject to inspection.

That belts work as shown and stated is certainly conclusive evidence that the theory of slack running is correct.

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Both driveR pulleys, 20-foot diameter, 62 revolutions per minute. Both driveN pulleys, 31-inch diameter. Distances between shaft centers 45 and 35 feet. Belt speeds, 3890 feet per minute.

Two 40-inch double leather belts that have been treated with Cling Surface since 1899, Broadhead Worsted Mills, Jamestown, N.Y. Under full load, 1000 horse power for both belts, the sag of the longer is over 48 inches while that of the shorter is over 22 inches. Both belts are clean, pliable and giving the best of service.

Scientific belt management —its importance and what it includes

Manufacturers who spend money freely and exercise greatest care with engines and operating machinery frequently overlook the importance of proper supervision for the transmission belts and ropes. The cost of the materials and labor for the repair of belts which have slipped or broken is the least part of the expense in connection with belt failures. The failure of a belt means the shutting down of one machine, in the case of a belt to or from a countershaft, or the shutting down of a group of machines or the entire shop in the case of an important belt driving a section of line shafting. Thus at least one, and possibly fifty or more workmen are paid for doing nothing during the ten minutes to one hour while the belt is being repaired or re-tightened. And it is usually during a rush, when the best belt service is essential, that such trouble occurs. The time of the men, moreover, is too often an insignificant part of the loss sustained. The value of the machine as a producer may be and often is far in excess of the value of the time of the man who runs it, and every minute that it is unnecessarily idle costs the plant real money. The care of belts is one of the fundamental features of Scientific Management.

A splendid example of this is found in machine shops. In attempting to bring the speeds of machines to a point advantageous with modern high-speed tool steels, it was and is a common experience for foremen and superintendents to find the belt slipping, and the lacing or the belt itself breaking before the desired speed is attained. Furthermore, from the antipathy of the man at the machine to bother himself any more than is necessary with a belt, and due also to his probable ignorance of the requisites of good belting practice, it is almost hopeless to expect belts to do their maximum work if left to the care of the man whose machine they drive.

The belt when left to the care of the machinist is, under ordinary handling, usually run much too loose to do good work. A deep cut or a heavy feed, either of which may be well within the capacity of the machine, usually will cause the belt to slip. Instead of putting the belt into better condition the natural thing for the workman to do is to reduce his feed or speed, or to take a lighter cut, or tighten the belt. The belt may then do the work, but the capacity of the machine is seriously reduced. Or instead, the man, in his ignorance, may apply rosin to the belt. This is the most harmful thing which can be done and should never be allowed. Rosin offers one of the quickest and surest routes to belt destruction. Another trick often seen in shops without systematic care of the belts is that of running the belt on steps of cone pulleys which are not in alignment. This is a "lazy man's device" which should not be tolerated for an instant, as the belt will soon twist and separate at the edges, and become ruined in a short time. The man at the machine, furthermore, is apt not to cut the ends of his belt square when he laces them, and the belt soon runs crooked on the pulleys.

Insurance against direct financial loss in any large plant demands that the power transmission system be placed in charge of one or more good men

DriveR pulley, 6-foot diameter, 75 revolutions per minute. DriveN pulley, 3-foot diameter. Distance between shaft centers, 20 feet. Belt speed, 1410 feet per minute.

A 20-inch 3-ply leather belt where Cling-Surface treatment rendered the use of a tightener unnecessary in the transmission of 100-horse-power load. J. S. Haggerty Brick Co., Detroit, Mich. Picture taken in April, 1903. See picture on opposite page.

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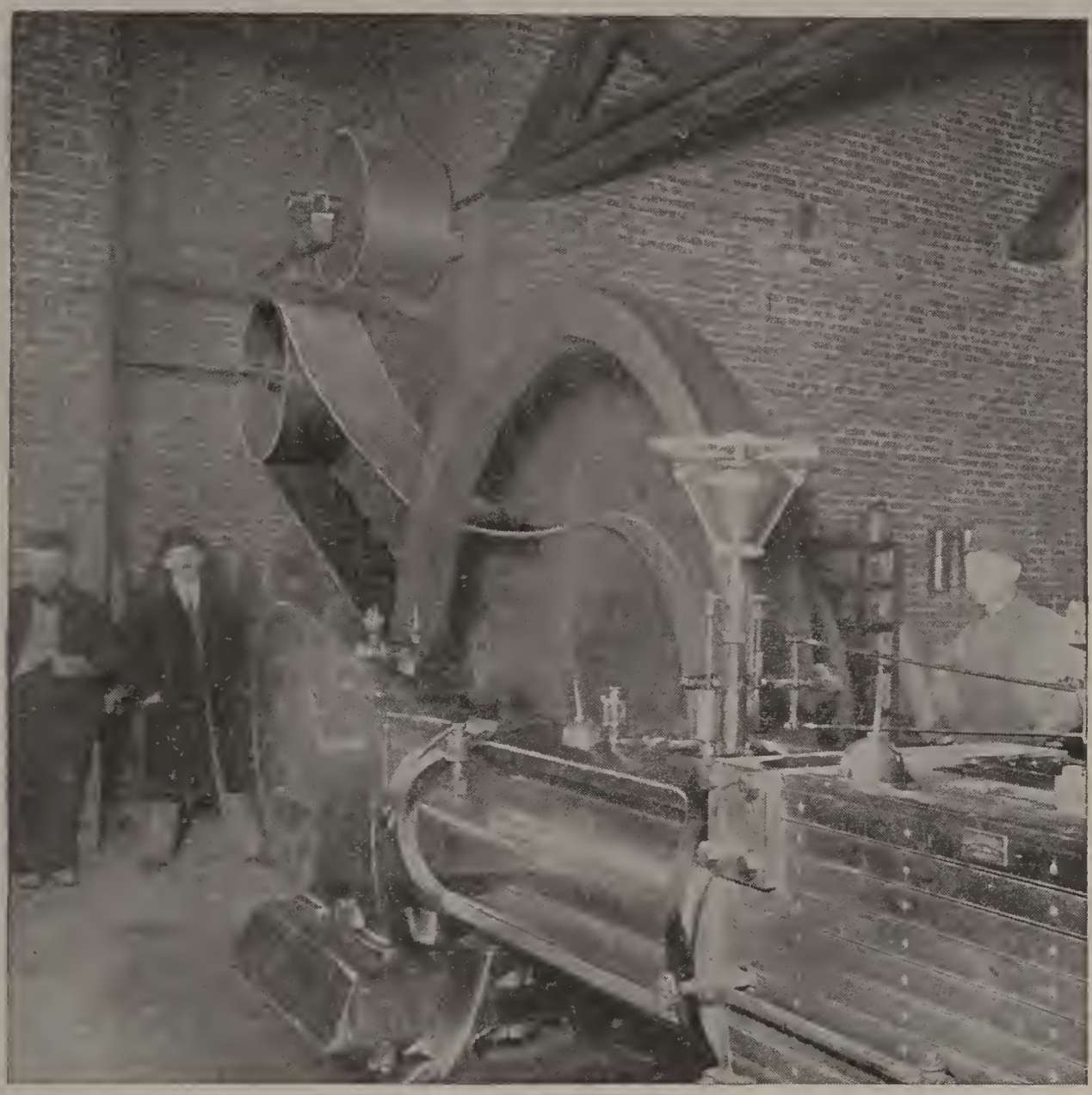
who are responsible for results. The belt problem is one not to be left to a "fixer," but should be studied by the superintendent, after which the belt-fixer can work under direction of superintendent or lesser official. Men authorized to keep their eyes open for power losses, etc., can take engine and shafting speeds at frequent intervals, record the data, figure and reduce the friction load, record lacings used and other vital expense items. They soon appreciate the advantage of applying the real remedy early and become interested and expert in all matters which affect the quantity and quality of power output and the expense of operation. Thorough system and localization of responsibility in this regard invariably saves money and assures the best belt service constantly.



Same belt as shown on opposite page, but photo taken nine years later (1912). During all this time the same engineer and same superintendent were in charge and the same Cling-Surface treatment was applied constantly. The same Cling-Surface salesman also appears in this picture. The tightener still hangs in the air and has not been used once. The belt is in better condition than ever and runs with greater slack due to the increased load applied with the corresponding increase in size of the plant.

To sum up:

Systematic belt management coupled with carefully designed drives will minimize belt failures and stoppage of machines, will promote a constantly efficient transmission system, will do much toward conservation of power, and will assure an ultimate economy not otherwise obtainable. The latter, of course, includes increased belt life and reduced maintenance.

These features are accomplished by:

(1). Having all belts systematically inspected and repaired at definitely predetermined intervals, so that slippages and breakages are anticipated and prevented.

(2). The maintenance of proper working conditions in the belt, so that it is able at all times to pull without slipping the heaviest load that should be imposed on it.

(3). By having the belts of such dimensions that the total load on them under the most severe service is well within safe limits, and with all lacing and splices properly made.

In his paper, "Notes on Belting," Mr. F. W. Taylor states that the total life of belting, the cost of maintenance and repairs, and the interruptions to manufacture are dependent chiefly on:

(1). The "total load" to which they are subjected; that is, the total stress per inch of width or per square inch of section on the tight side of the belt while in motion.

(2). Whether the belts are spliced or fastened with lacing or belt hooks.

(3). The speed at which they are run.

(4). Whether they are properly preserved and kept free from machinery oil.

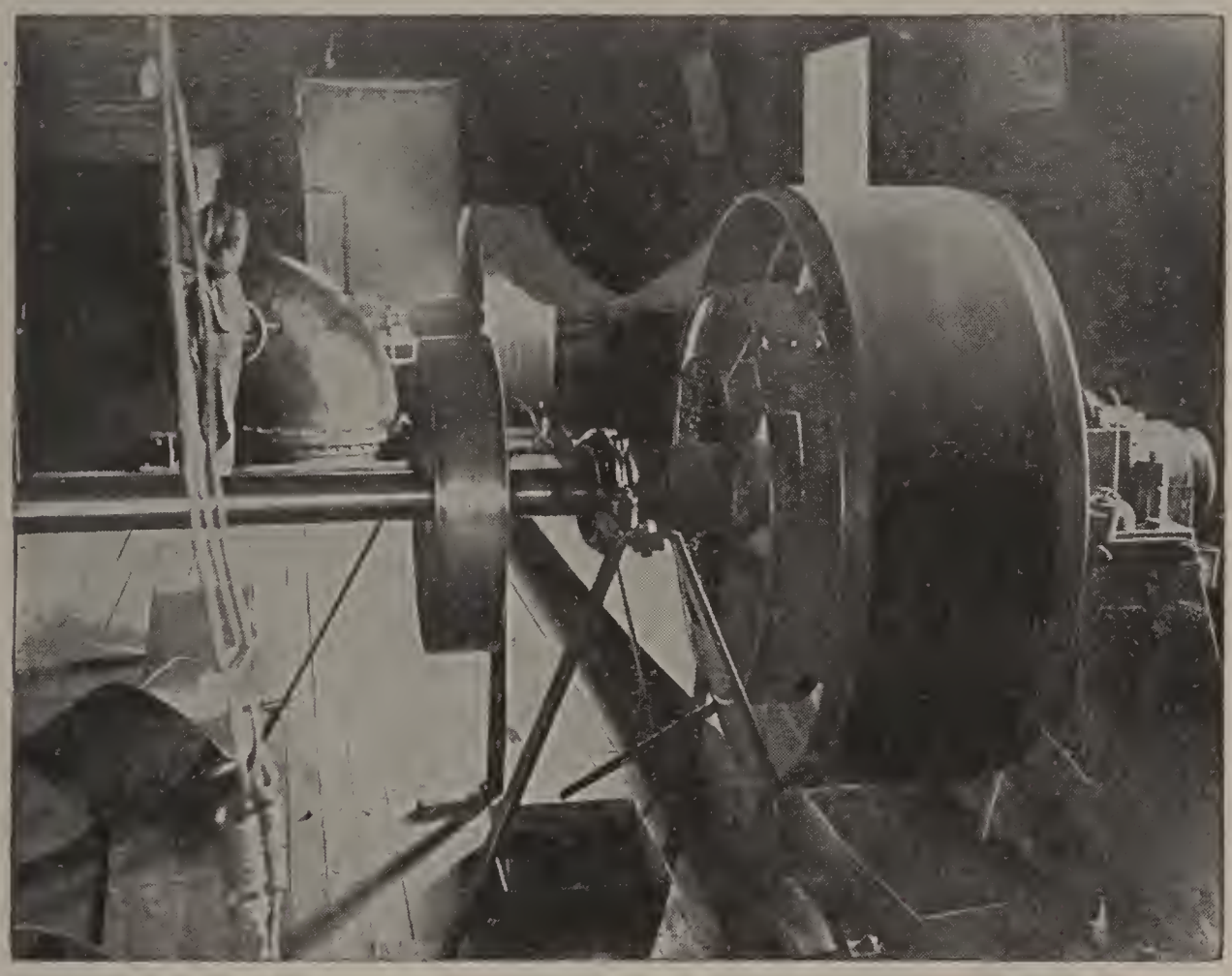
These matters are all thoroughly discussed in the following pages.

Typical Cling-Surface-treated belt. Pliable, waterproof and no slip. Plenty of slack to give increased pulley contacts at all loads.

Preservative treatment a first essential to any transmission belt or rope

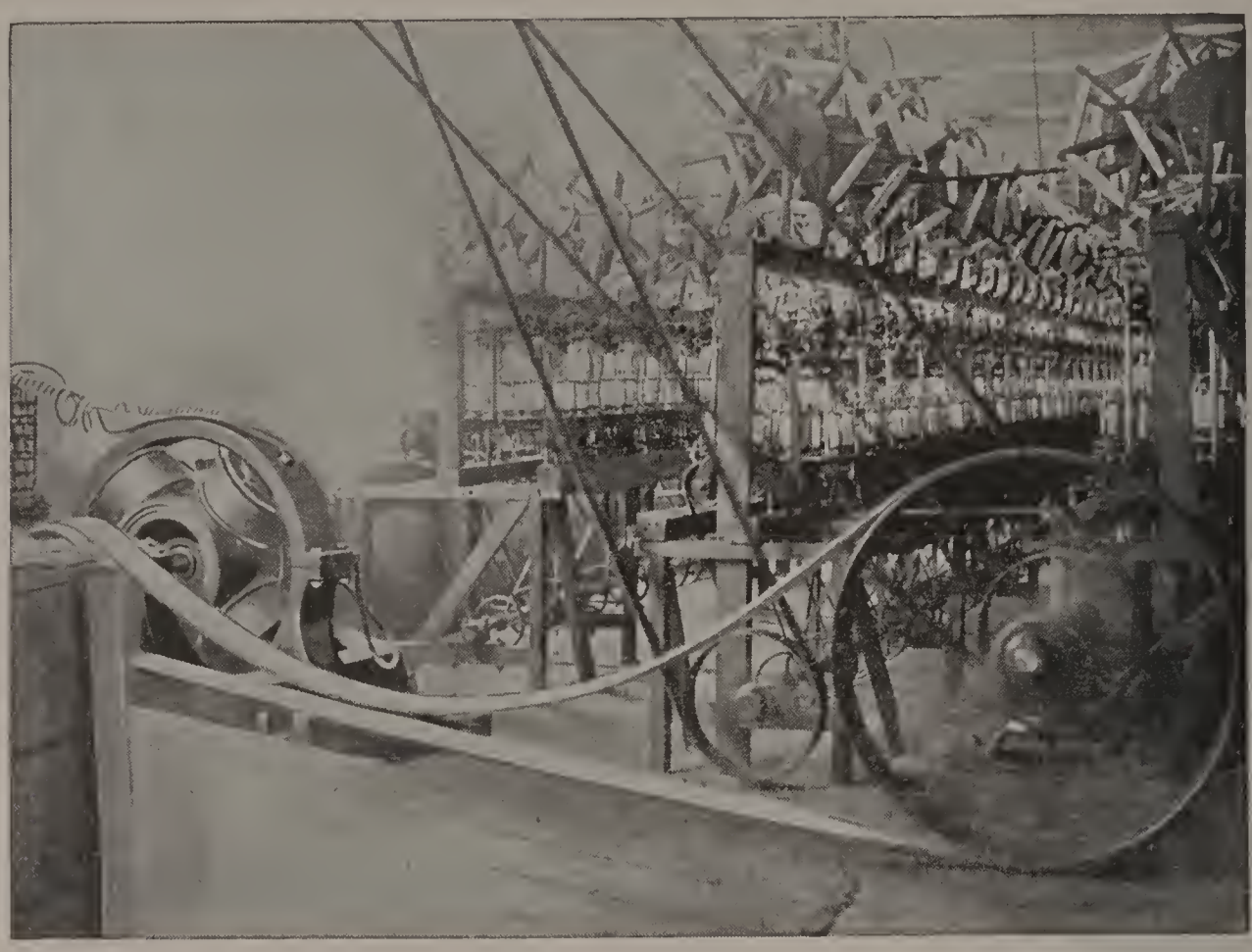
Transmission belts and ropes, regardless of classification, are all animal or vegetable matter, which may be allowed to perish quickly in service or can be preserved in health and vigor throughout a long and useful life.

Belts and ropes are of course supposed to be turned out by their makers in the best possible condition, yet mere animal or vegetable tissue cannot be expected to carry *unaided* a tremendous load, often run at the speed of a locomotive, be bent back and forth hundreds of times per minute and subjected to all sorts of temperature, moisture, weather and other conditions. In any service there must be friction within, due to the rubbing of the fibers



DriveR and driveN pulleys, 4-foot diameter, 345 revolutions per minute. Distance between shaft centers, 21 feet. Belt speed, 4330 feet per minute.

A good example of benefits from intelligent use of Cling-Surface. The 14-inch double leather belt transmitting from a water wheel in the plant of the Ludlow (Vt.) Electric Light & Power Plant, sags 18 inches with 80-horse-power load and transmits 125 horse power with sag of 22 inches during peak periods. Cling-Surface treatment was started here in 1901, and at an average cost of 27 cents per year for the Cling-Surface this belt has given perfect service for twelve years and is now in perfect condition.



DriveR pulley, 6-inch, and driveN pulley, 35-inch diameter. Distance between shaft centers, 10 feet. Belt speed, 1200 feet per minute.

A 6-inch double leather motor belt that with Cling-Surface treatment took the place of an 8-inch double without Cling-Surface in transmitting 25 horse power. Since 1905 all belts in this plant, Hanscom Bros., Fall River, Mass., have been converted to the slack system practical with Cling-Surface treatment. Previously many dressings had been tried without relief from belt troubles save for a few days at a time, and this firm had decided tight belts could not be avoided. Now, however, their belts are in perfect condition, and there is not the least belt trouble.

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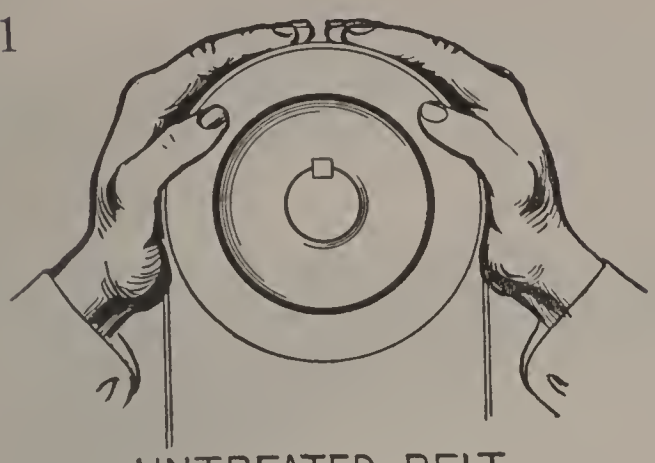
against each other, and this friction in turn produces heat. The heating effect is further often intensified by hot dry surrounding air and always, where slip is present, by the rubbing under pressure of the belt or rope against the pulley or sheave faces. It is only reasonable therefore that the soft surface material and the natural oily ingredients will dry or burn out and that the ingredients consumed must be replaced by some equivalent. Leather and vegetable fiber must be nourished and protected from wear and tear or must die before its time, just the same as a human being. No belt can stand up to tremendous physical work for months, with no help, without showing the strain sooner or later, usually sooner.

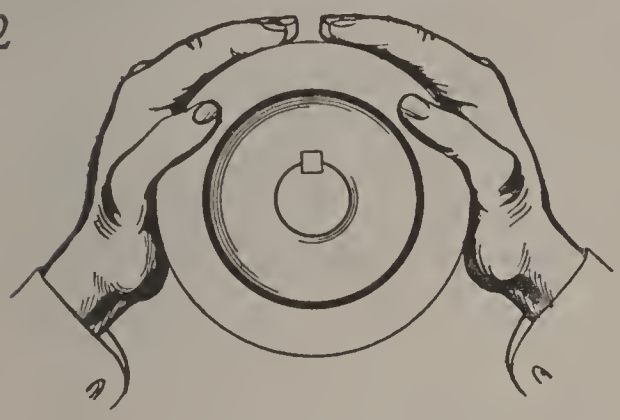
Ultimate economy in belt service therefore depends primarily upon keeping the belts pliable, healthy, vigorous, clean and impervious to surroundings—able and ready to work. This is accomplished in the highest degree

1



UNTREATED BELT

2



BARE HANDS

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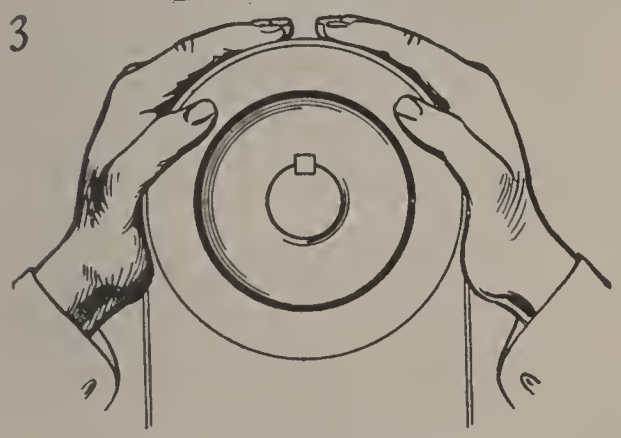

CLING-SURFACE
TREATED BELT

A simple test which demonstrates the action of Cling-Surface.

1. Fasten any ordinary small pulley in some convenient position and with fingers as shown grip an untreated belt.

2. Next grip pulley with bare hands only.

3. Then try the same thing with a Cling-Surface-treated belt. You can easily feel the decided difference in resistance to slip.

It is simply a matter of cohesive contact. The untreated belt, being hard and inelastic, can't be expected to conform perfectly to the pulley face, while the bare hand, being moist and soft and yielding, takes equally effective hold over all area covered. Similarly a belt properly treated with Cling-Surface becomes pliable and "clinging" so that it offers the same high resistance to slip, but is never sticky on the surface. Cling-Surface imparts to and maintains the soft velvety cling IN, but leaves no deposit ON, the belt surface, hence there need be no collection of dust or forming of lumps. Further, the prevention of slip is accomplished by COhesion, not ADhesion. The belt leaves the pulley without effort after contact, which is in marked contrast to the action where a sticky preparation holds pulley and belt together at the expense of power loss and injured belt surface in tearing them apart.

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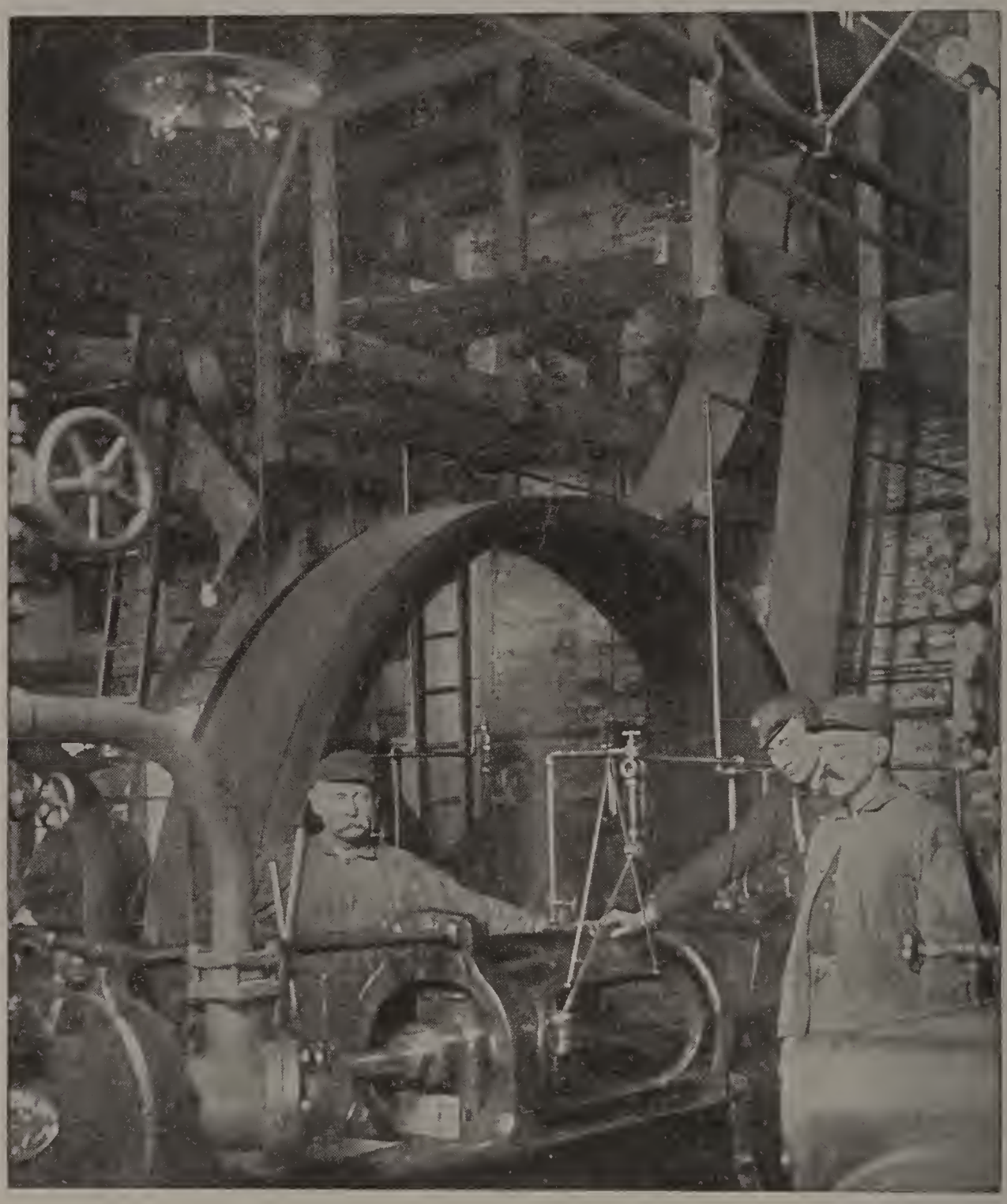
by consistent systematic treatment with Cling-Surface, because Cling-Surface is a clean neutral preservative and lubricating food that makes and keeps belts and ropes mellow, flexible, water-proofed and durable. It penetrates the interior, fills and surrounds each fiber inside and out, so that the fibers work against their neighbors with the least friction. It gives to a belt face a soft velvety smoothness, hard to describe yet vivid to feel, a clinging surface, like your damp hand as compared to a dry hand, not sticky, but clean. Nothing is left on the belt face. It is *in* the face. It is the "cling" which nothing but Cling-Surface gives.

Cling-Surface which has once penetrated a belt or rope tends to stay there and renders its physical benefits permanently, thus promoting an ultimate economy that in itself will well repay the slight cost and effort of applying the Cling-Surface.



DriveR pulley, 12-foot diameter, 62 revolutions per minute. DriveN, 30-inch diameter. Distance between shaft centers, 16 feet. Belt speed, 2340 feet per minute.

The 16-inch Gandy belt of the Rosslyn (Va.) Packing Co. drives a 50-ton ammonia compressor, transmits 300 horse power and has been treated with Cling-Surface since 1908. This belt is pliable, never slips, never gives trouble and is in the condition that only Cling-Surface will assure. The 30 inches of sag gives an additional contact of 3 feet on the driving pulley and also gives a substantial increase on the driven pulley.

Slack vs tight belts

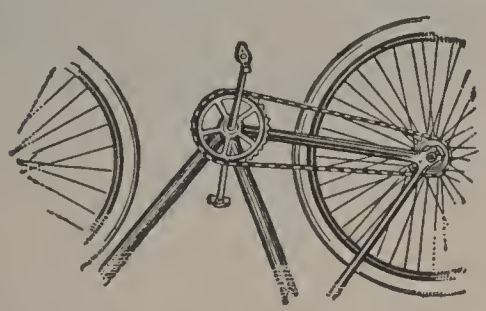
Unfortunately for themselves power users long considered belt tightening the only means of preventing slip, and virtually *whip up* their belts to force more work instead of *putting them into better condition* so that they could do it.

The initial tension, formerly considered a necessity, is of absolutely no use save to prevent slip, and in other ways is positively so detrimental that when figuring on ultimate economy the objections far outweigh the benefits, save in rare exceptional cases.

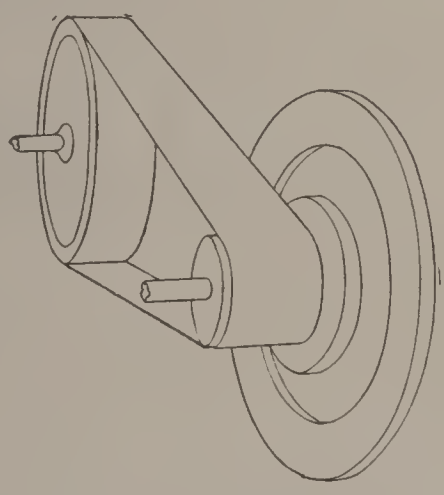
A parallel case that every bicyclist can appreciate

Tight belts are just as harmful as tight chains. In the prevention of slip, Cling-Surface treatment accomplishes the equivalent of teeth on a sprocket.

Wrong Way

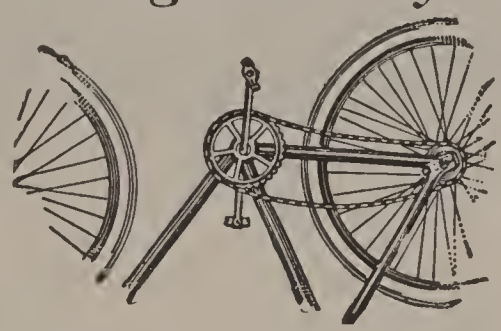


Tight chain; runs hard, pops, climbs sprocket teeth and breaks balls in the bearings.

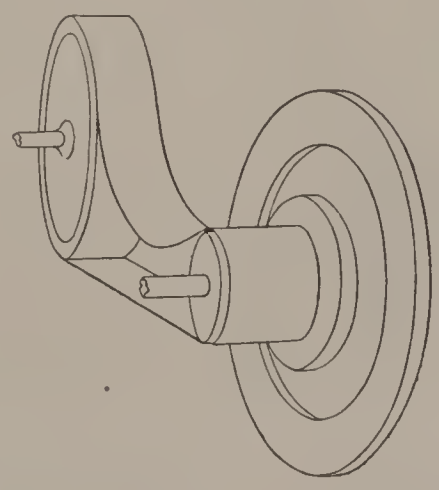


Tight belt; strains belt, pulley, bearings, hanger and shafting. A prolific cause of hot boxes and burned belt surface.

Right Way



Loose chain; runs easy, noiseless, meshes perfectly and absorbs little power.



Cling-Surface belt; slack but no slip, soft velvety surface, all internal belt strains eased, bearings run cooler, power saved and belt preserved.

In Prof. Goodman's text "Mechanics Applied to Engineering" it is shown that, if properly lined up, a solid shaft with ordinary bearings would transmit power a distance of 6,000 feet with an efficiency of 80 per cent, when all

DriveR pulley, 4-foot diameter, 213 revolutions per minute. DriveN pulley, 14-inch diameter. Belt speed, 2,670 feet per minute

Running tight before Cling-Surface treatment. *See opposite page.*

forces are purely torsional. With belts, in which bending and torsion are necessarily combined, that distance drops to 400 feet. Still, 400 feet is a much greater distance than is accomplished by shafting under ordinary conditions with an efficiency of 80 per cent. An efficiency of 60 per cent is high. It is not uncommon to allow a 50 per cent. loss of power in the shafting of many modern machine shops.

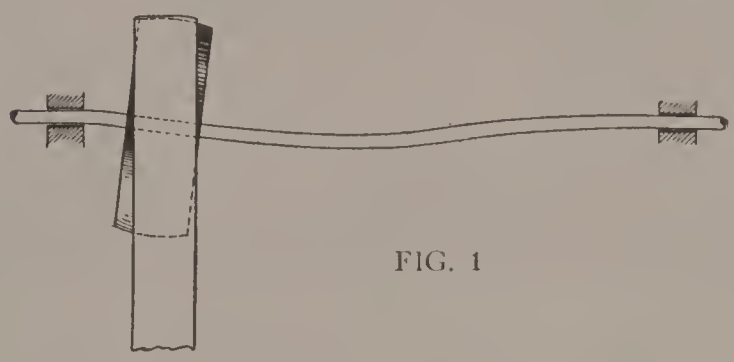
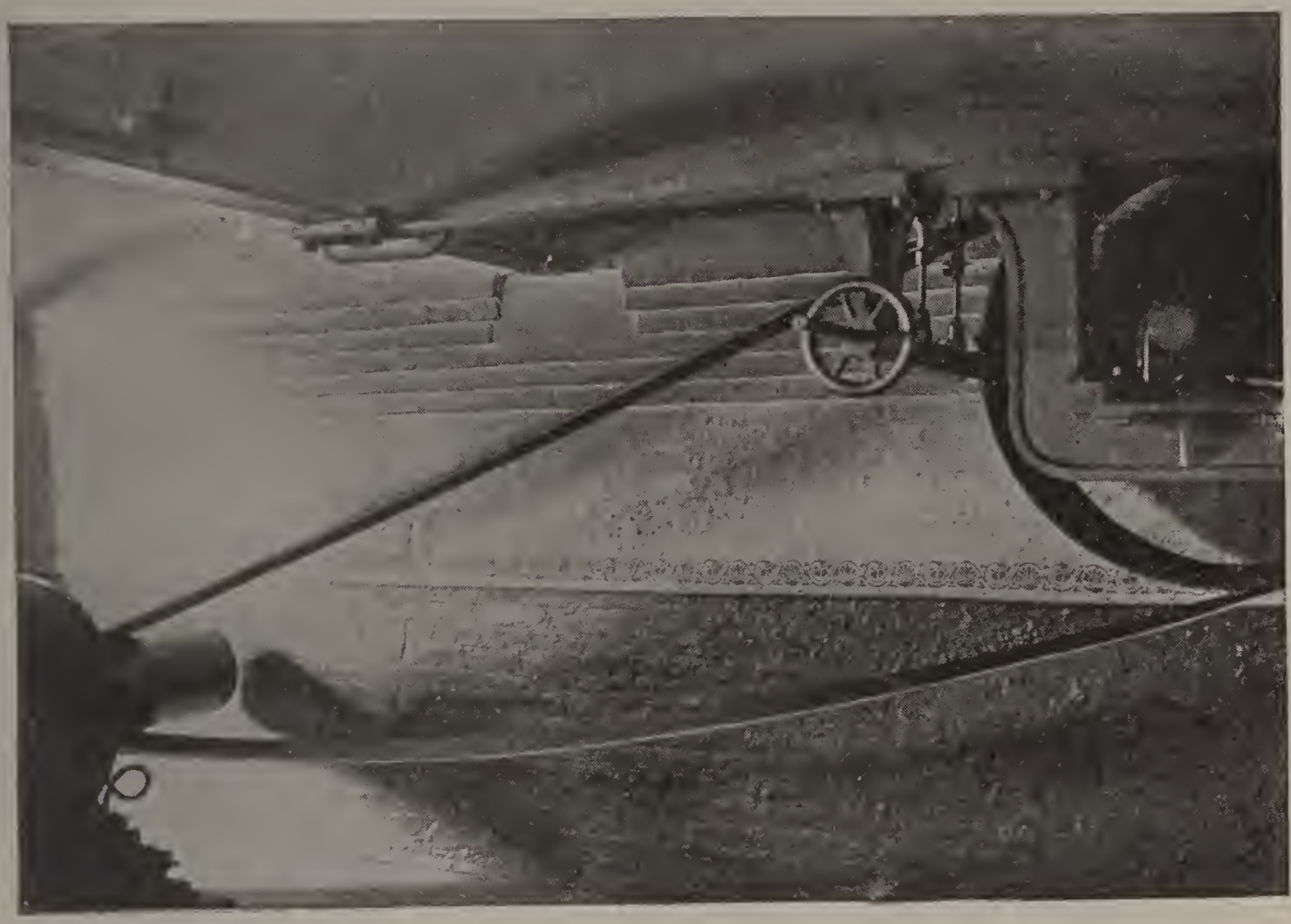


FIG. 1

Many belt drives are arranged as shown in Fig. 1, with only one hanger to give rigidity to the driven pulley. The enormous tensions in a tight belt are sufficient to deflect the shafting considerably. In practice the deflection is not so marked as is shown here, but the slightest deflection seriously affects the transmission efficiency, as Prof. Goodman forcibly indicates. In operation the shafting maintains that form, and the friction, both internal and in the bearings, increases with the amount of deflection.

Tests made by a prominent cotton mill engineer and quoted in Kent's "Mechanical Engineers' Pocket-Book" (in chapter on "Evils of Tight Belts") showed that in eight modern mills with first-class shafting the power required to run the shafting alone ranged from 25 to 39 per cent of the total. Commenting upon these figures, this engineer is further quoted as follows:

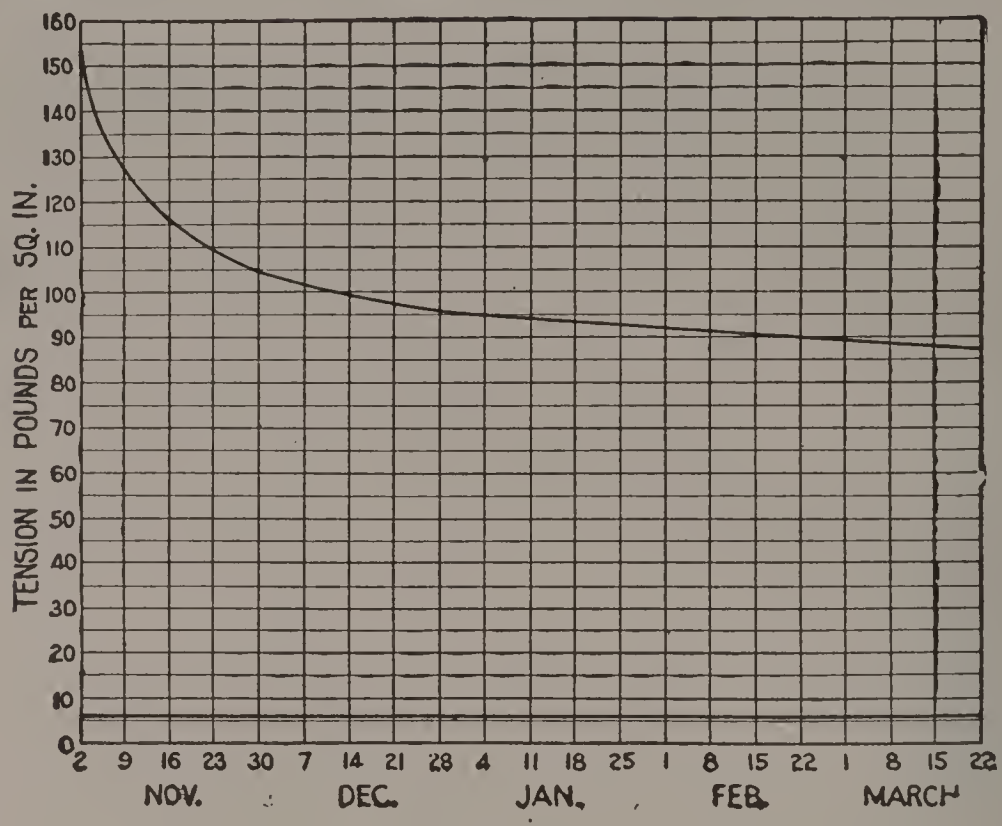


Running slack after Cling-Surface treatment.

A 12-inch camel's hair belt on an overdrive in Townley Mill, Middleton, N. Manchester, England, which shows typical benefits from Cling-Surface treatment.
Originally this belt drove a 682-light dynamo (first photo) and even when treated with castor oil had to be run very tight, with a man standing by to prevent slipping off the pulleys. Later Cling-Surface was applied to the belt and an 850-light dynamo was substituted. In spite of the 25 per cent load increase, the same belt now runs quite slack as shown in this second photo and requires no attention.

> "These may be taken as a fair showing of the power that is required in many of our best mills to drive shafting. It is unreasonable to think that all that power is consumed by a legitimate amount of friction of bearings and belts. I know of no cause for such a loss of power but tight belts. I believe three-quarters of the trouble experienced in broken pulleys, hot boxes, etc., can be traced to the fault of tight belts. The enormous and useless pressure thus put upon pulleys must in time break them, if they are made in any reasonable proportions, besides wearing out the whole outfit and causing heating and consequent destruction of the bearings."

Further, even if a belt is tightened until the bearings run hot the relief from slip can be only temporary and each subsequent tightening puts the belt into worse condition.



The upper curve (Trans. A. S. M. E., Vol. 31, Page 43) indicates the fall in tension in a leather belt 5⅜ inches wide by $\frac{1}{32}$ inch thick, while driving a large rotary planer, and depending upon initial tension to prevent slip. That tightening to prevent slip is dead wrong is well proven by the conditions represented here. Frequent readjustment of the tension here would be necessary, would involve considerable labor expense and would certainly lead to rapid destruction of the belt.

There would be no variation in initial tension if this belt were treated with Cling-Surface for the simple reason that there need be no initial tension other than the weight of the belt. Assuming a distance of twenty feet between pulley centers and a five-inch sag (which is small on such a belt filled with Cling-Surface) and figuring for the same belt as used above, there would be but six pounds initial tension per square inch of belt section.

In the light of modern practice, such belt slackening is to be encouraged. It is far better and quite practical to keep the belt throughout in a condition that permits it to run slack without slip. In fact, slack or easy running belts, with freedom from initial tension, are essential to perfect transmission. It has always been possible to run belts easy or slack where the belts are extra wide or heavy, and now with Cling-Surface treatment, any overworked belt, staggering along under heavy working load plus the friction load of initial tension, can be eased with immediate, lasting and very apparent benefit.

On the average belt treated with Cling-Surface, the idle half, if it is on top, can be run so slack that it will almost touch the working half, and this slackness increases contact areas on both driving and driven pulleys. A 40 per cent increase of contact area is not uncommon and this with the interior flexibility and surface softness imparted by the Cling-Surface gives the belt a maximum gripping power and transmission efficiency.

We began in 1897 this practice of *intentionally slackening a belt to get increased transmission* with the belt shown on page 17 and the results there stated. Some belts, when treated systematically with Cling-Surface, can be run slacker than others. Some must fit closely, others can be slackened until the sag just clears the driving side (on bottom drive). A belt treated

The first belt treated with Cling-Surface and purposely slackened to increase pulley contact and power-transmitting capacity, Union Dry Dock (Erie R. R., Buffalo, N. Y.), 1896. This was an old 12-inch leather belt, stretched out dead under years of tension and would not drive at one time all the machines on the driven shaft. A few applications of Cling-Surface and slackening not only eased the tension and gave plenty of power, but actually permitted several new machines to be added to the line. The increased power from this one belt for two years was worth $640 to them, at a cost of $63 in Cling-Surface for the whole works, and Cling-Surface restored to this belt its lost elasticity and vigor.

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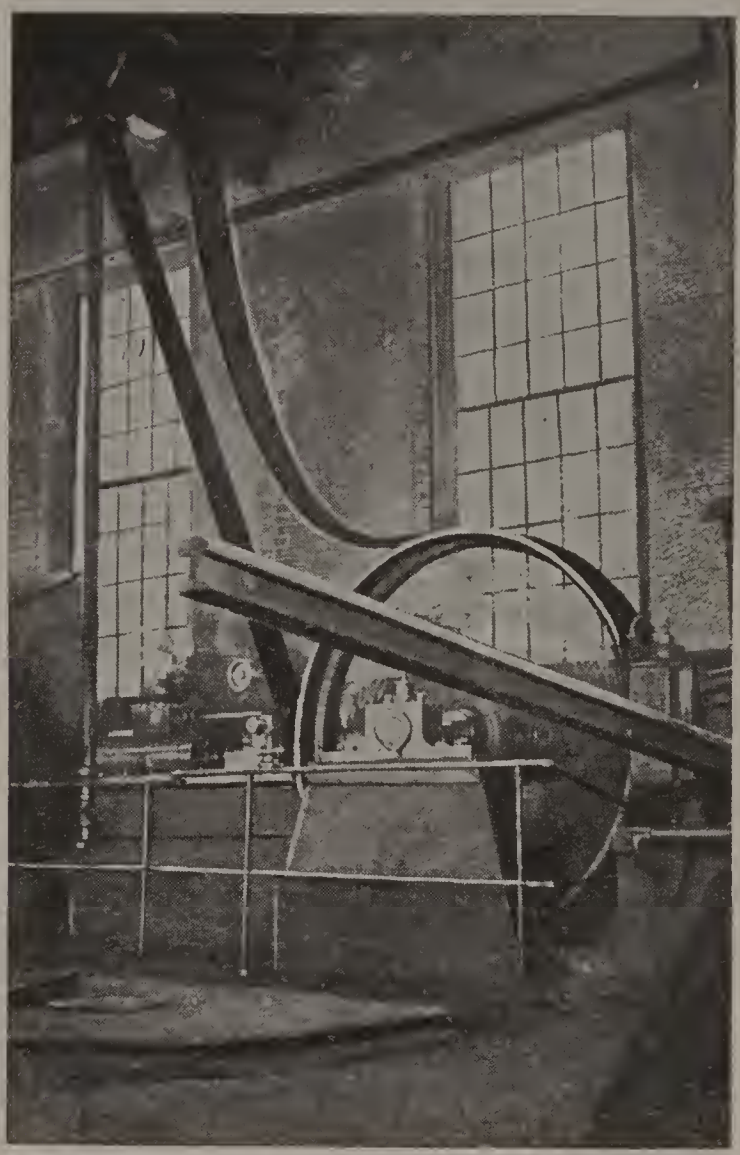
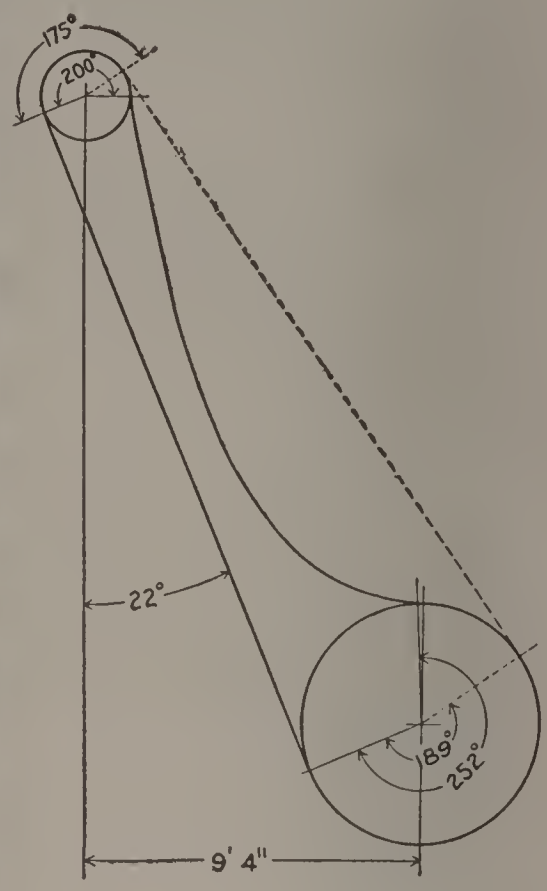
with Cling-Surface and run slack lets the power formerly wasted come through to the machines and increase their output. That this is not mere theory but hard fact has been proven *in every plant in which systematic Cling-Surface treatment has been used*. The photographs throughout this book are further testimonials of what has been accomplished.

The terms "easy" and "slack" are relative. All belts can be run easy and many can be run slack, or loose. Vertical belts, if very slack, would simply drop away from the lower pulley, so they should be run easy—just snug enough to keep in contact with the pulley, but never tight. Most belts of over 20 degrees angle from the vertical can be run slack and the slacker





DriveR pulley, 6-foot 8-inch diameter, 83 revolutions per minute. DriveN pulley, 30-inch diameter. Distance between centers of shafts, 19 feet 6 inches. Belt speed, 1783 feet per minute.

Showing the possibilities of Cling-Surface treatment in improving the transmission power of a semi-vertical belt. The above 12-inch double leather belt in a large railroad shop carried a hard load of punching and shearing machinery. Previous to Cling-Surface treatment this belt ran tight and due to slipping and power consumed in friction, power was always short, bearings ran hot and there was constant trouble. After Cling-Surface was applied, the belt was slackened, by inserting an 18-inch piece, so that it wrapped 252 degrees of the pulley, an increase of 63 degrees over its old position, and about half this increase on driven pulley. This increased wrap with the removal of tightening strain and friction and the cure of all slipping, which both Cling-Surface and the wrap effected, gave more power than had ever been obtained before, in fact, a margin over needs; bearings are always cool, oil is saved, time, labor and worry are saved, maximum results are obtained and at least operating expense.

DriveR pulley, 14-inch diameter, 570 revolutions per minute. DriveN pulley, 8-foot diameter. Distance between shaft centers, 28 feet. Belt speed, 2090 feet per minute.

14-inch leather motor belt transmitting 100 horse power to an air compressor in the plant of the Golden Gate Mining Co., Grass Valley, Cal. Belts in this plant are painted face and back with Cling-Surface, and concerning the one above, the chief engineer says that at times it runs so slack that the sides just clear, yet he has seen no sign of slip.

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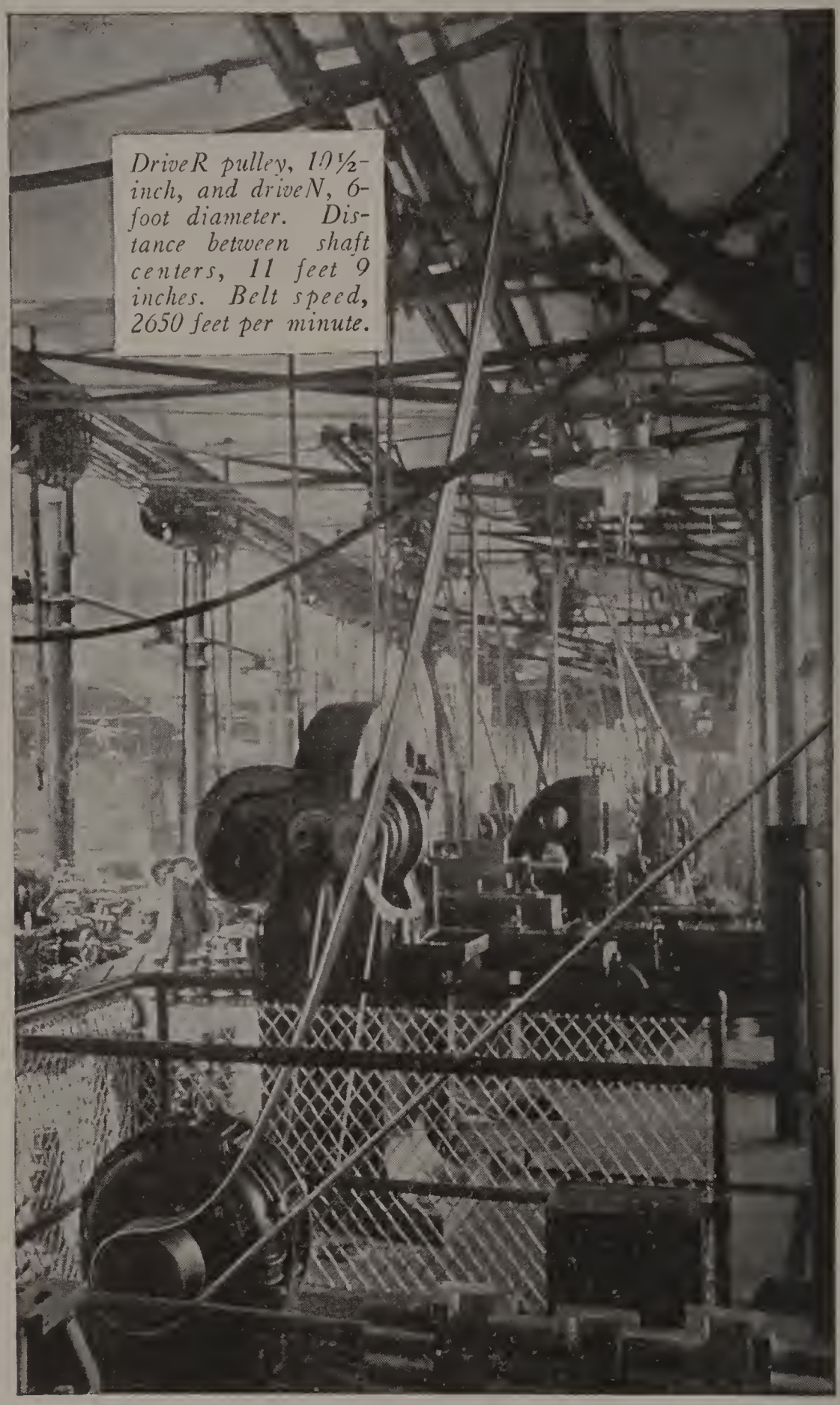
they run the more of the pulley they will wrap and the more power they will transmit. In many instances, the increased weight of belt between the pulleys obtained by running very slack will make the belt run better than if only a trifle slack. The increased weight overcomes the centrifugal force which tends to throw the belt over and beyond the driven pulley, while the added pulley contact adds to the efficiency.

A tight belt grips only about half or 180 degrees, of the pulley circle, while a belt run slack often grips 260 degrees and more. Naturally the more contact surface the more pull, and this is especially advantageous on small pulleys and belts having short distance between centers.

Mr. H. H. Yates, one of whose belts is shown on page 21, very nicely explains the advantage of the loose belt in an article in the *Practical Engineer* as follows:

> "Suppose that we take for an example a 6-inch single belt running over two pulleys, say 30 inches in diameter, with 10 feet center to center (Fig. 1, page 21).

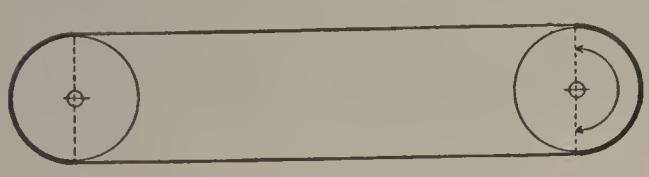


Belt at the English Daimler Motor Works (See page 22) which shows the remarkable advantage of Cling-Surface treatment for belts driving from small pulleys. This belt transmits 14 horse power and in spite of the high belt speed does its work perfectly. The photograph, taken under full speed and load, shows the true running and the increased pulley wrap due to Cling-Surface.

DriveR and driveN pulleys, 8-foot diameter. Distance between shaft centers, 25 feet. Belt speed, 2140 feet per minute.

A thirteen-year-old 26-inch 2-ply leather belt that transmits 140 horse power and since Cling-Surface treatment runs with 48 inches of sag. Sometimes the load here (Maddock Pottery, Trenton, N. J.) goes up to 156 horse power.

The "theoretical" capacity of this belt is 136 horse power, so that the "overload" sometimes reaches nearly 15 per cent. However, Chief Engineer H. H. Yates tells us, "This belt never slips, but as the peak load comes on, simply sags farther down on the pulleys."



FIG, 1. TIGHT BELT

FIG. 2. LOOSE BELT

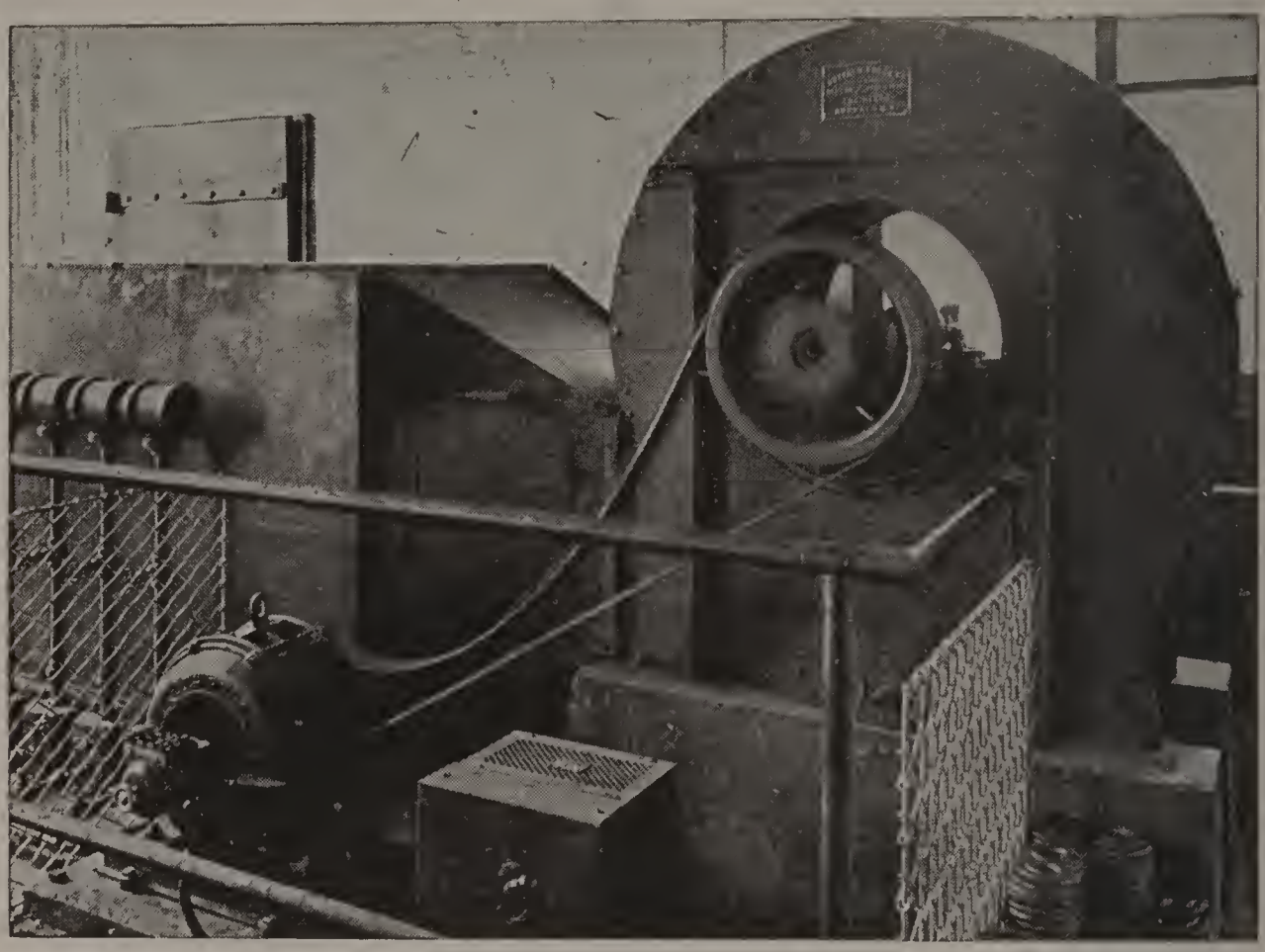
"The circumference of a 30-inch pulley equals 30x3.1416= 94.248 inches. If the belt is tight, 0.5 or 180 degrees of the pulley circumference will be in contact with the belt or 47.124 inches. 47.124x6 (the width of the belt)=282.744 square inches of leather in contact with the pulley.

"Now suppose that the belt is made loose enough to wrap 225 degrees or 0.625 of the circumference (Fig. 2) of the pulley. 94.248x 0.625=58.905 inches, which, multiplied by 6 (the width of the belt) equals 353.43 square inches in contact instead of 282.744, and *this is only a small belt.*

"While we have been increasing the area of the belt in contact with the pulley, we have at the same time secured another beneficial result in that we have decreased the friction load on the bearings. Assuming that the belt when standing is under a strain

of 25 pounds per inch of width, easily obtainable; 25x6x2=300 pounds, this transmitted to the bearings, which might probably be 2.5x7=17.5 square inches, $\frac{25x6x2}{2.5x7}$=17.1428 pounds per square inch.

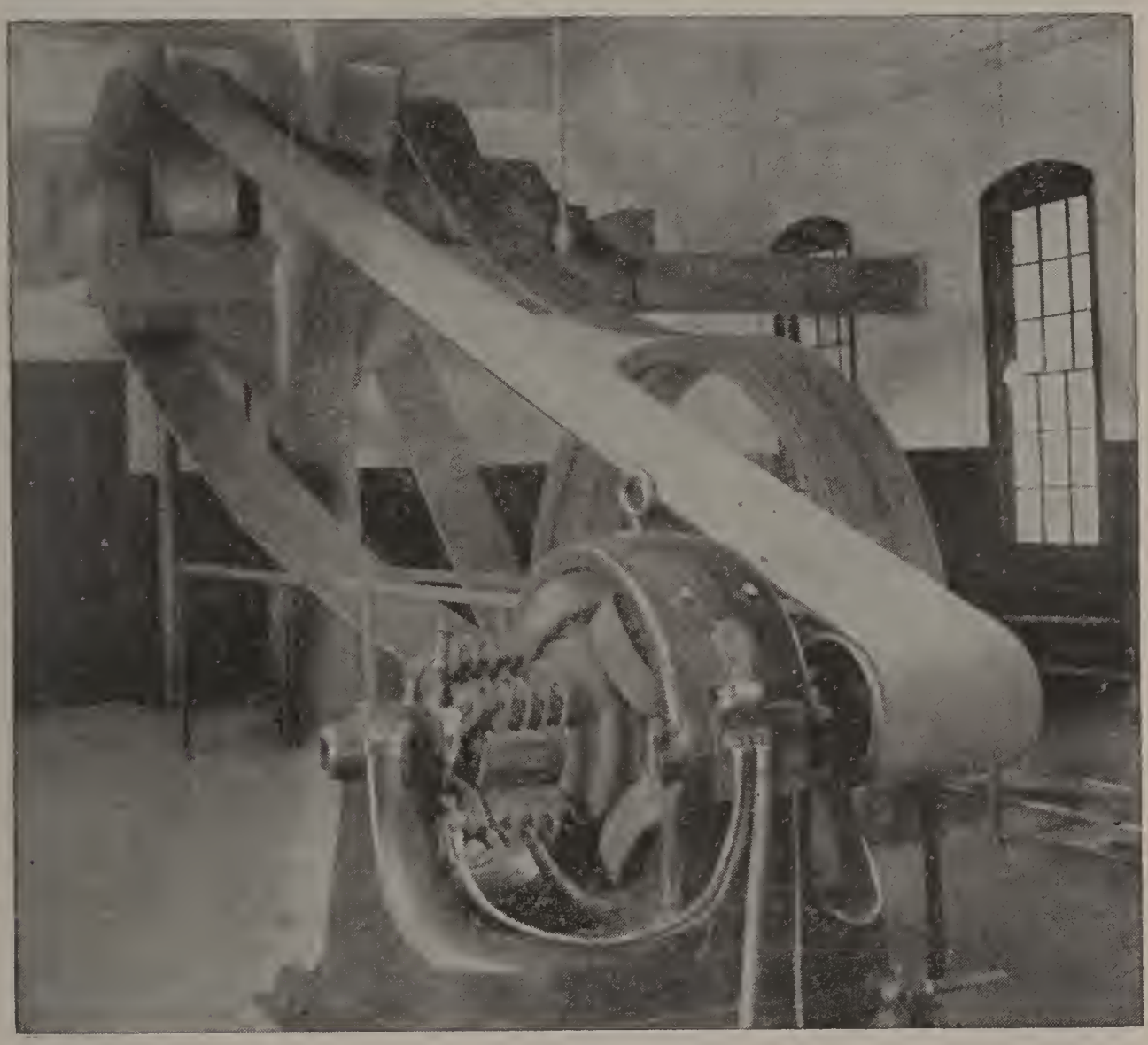
"In the second case there would be only 3 or 4 pounds per inch, little more than the strain due to the weight of the belt. Taking the larger figure $\frac{6x2x4}{2.5x7}$=2.7428, say 2.75 pounds per square inch, a difference of 14.4 pounds per square inch.



DriveR pulley, 8-inch diameter, 965 revolutions per minute. DriveN pulley, 18-inch diameter. Distance between shaft centers, 5 feet. Belt speed, 2020 feet per minute.

This fan belt (Scandinavian), 7½ horse power, is a typical example of how the Daimler Motor Co., one of the largest English automobile builders, run their belts under Cling-Surface treatment, which has been applied to their plant in Coventry since 1905. The drives from electric motors (of which they have about 100) are run without initial tension, and an arc of contact in some instances of as much as 270 degrees is obtained with the pulleys. The belts hang very loosely when they are idle; in spite of this there is no trouble in starting the motors, and, although the load may vary at any moment, slipping of the belts does not take place. The relief afforded by Cling-Surface treatment in doing away with tightness on 100 or more belts here has been very considerable.

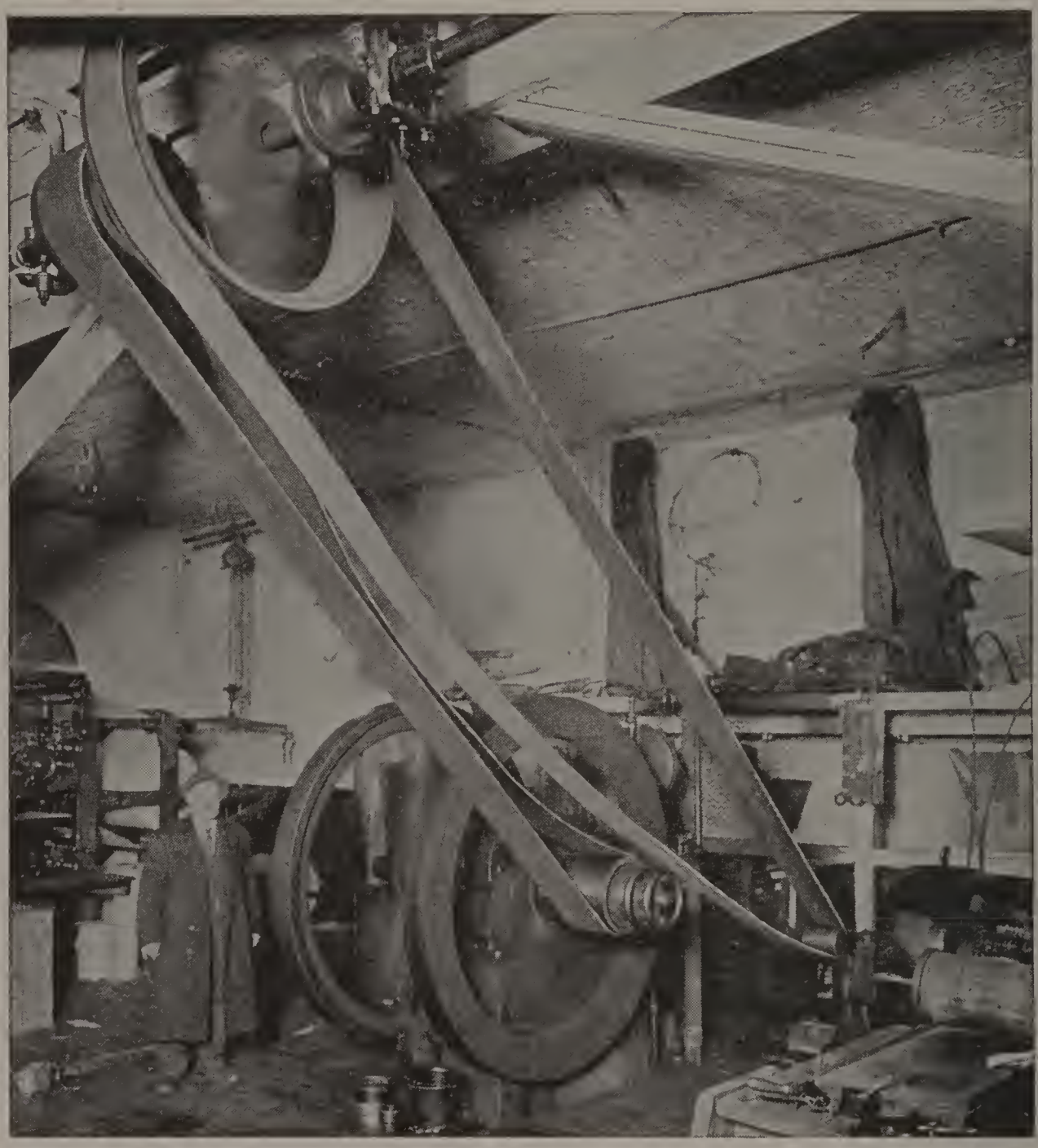
"At one time, the writer, wishing to test the matter by an experiment, connected a small motor to a small machine in such a way that the tension on the belt could be easily varied. With belt slack the motor could run the machine up to speed; increasing the tension on the belt, the speed was reduced until the belt was very tight and the motor was unable to run at all."



Main driveR pulley (back of dynamo), 10-foot diameter. DriveN pulley, 5-foot diameter, 90 revolutions per minute. Distance between shaft centers, 18 feet. Belt speed, 1412 feet per minute. Shaft pulley (upper left corner), 67-inch diameter, dynamo pulley, 16-inch diameter, 750 revolutions per minute. Distance between shaft centers, 31 feet. Belt speed, 3140 feet per minute.

Two typical Cling-Surface-treated belts (both 19-inch double leather) in the plant of the American Meter Co., Erie, Pa. The overpull belt (in the foreground) never slips any more than the main belt (in the background), the latter transmitting 90 horse power and both belts running with 24 inches of sag.

Cling-Surface has been used for 15 years in this plant, and in the six years' service of the above belts, slack has been taken up but once. At no time have these belts given trouble, this splendid condition, they agree, being due to the use of Cling-Surface.



DriveR pulley (on engine), 13-inch diameter, 240 revolutions per minute. DriveN pulley, 16-inch diameter. Distance between shaft centers, 11 feet. Belt speed, 816 feet per minute. DriveR pulley (on shaft), 40-inch diameter. DriveN pulley (on dynamo), 6-inch diameter, 1300 revolutions per minute. Distance between shaft centers, 15 feet. Belt speed, 2040 feet per minute.

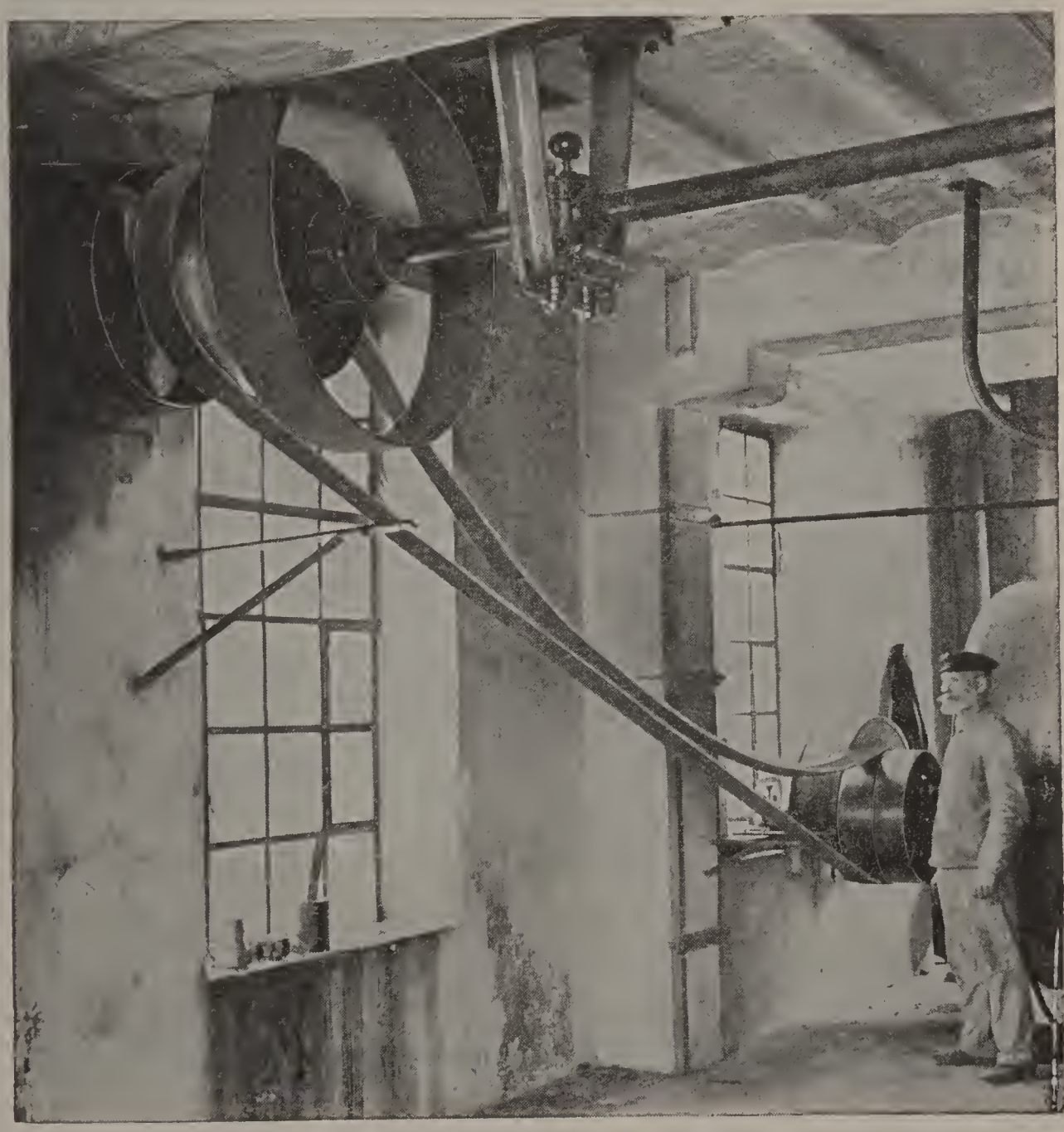
10-inch gas engine (20 horse power) and 6-inch dynamo belts in the plant of the Register-Leader, Marietta, Ohio. The small pulleys, the top pull on the dynamo belt, and irregular loads of printing machinery offer an extremely hard test for Cling-Surface, but since 1906, when the treatment was started, both belts pull full loads without slipping.

However, even the increased pulley wrap as a benefit is secondary to improved physical condition of the belt under Cling-Surface treatment, as is proven by the fact that a belt previously run tight on an *over* drive is less apt to slip when run slack, and with decreased pulley wrap, after Cling-Surface treatment. The hanging of an overdrive away from the pulleys when the

belt is treated with Cling-Surface does no harm if enough power is transmitted. If the slack is sufficient to greatly decrease the pulley wrap, and does let the belt slip, the full benefit from the Cling-Surface treatment can be obtained by putting an idler up under the slack to bring it into pulley contact —not tight, but just a loose fit. The benefits from Cling-Surface treatment and slack running even on overdrives are shown in illustrations on pages 23 and 24.

Cling-Surface reaches the very foundation of perfect belt service by making the belt vigorous, pliable, healthy and permitting it to come into perfect pulley contact at all points. The belt face remains like the best new calf-skin, with nothing sticky on the surface. Like the action of a moist hand on a tool handle, the belt surface grasps the pulley, adapts itself perfectly to the pulley surface, pulls and releases at will, while the body of the belt is in the best possible condition to strengthen and back up the pulley grip.

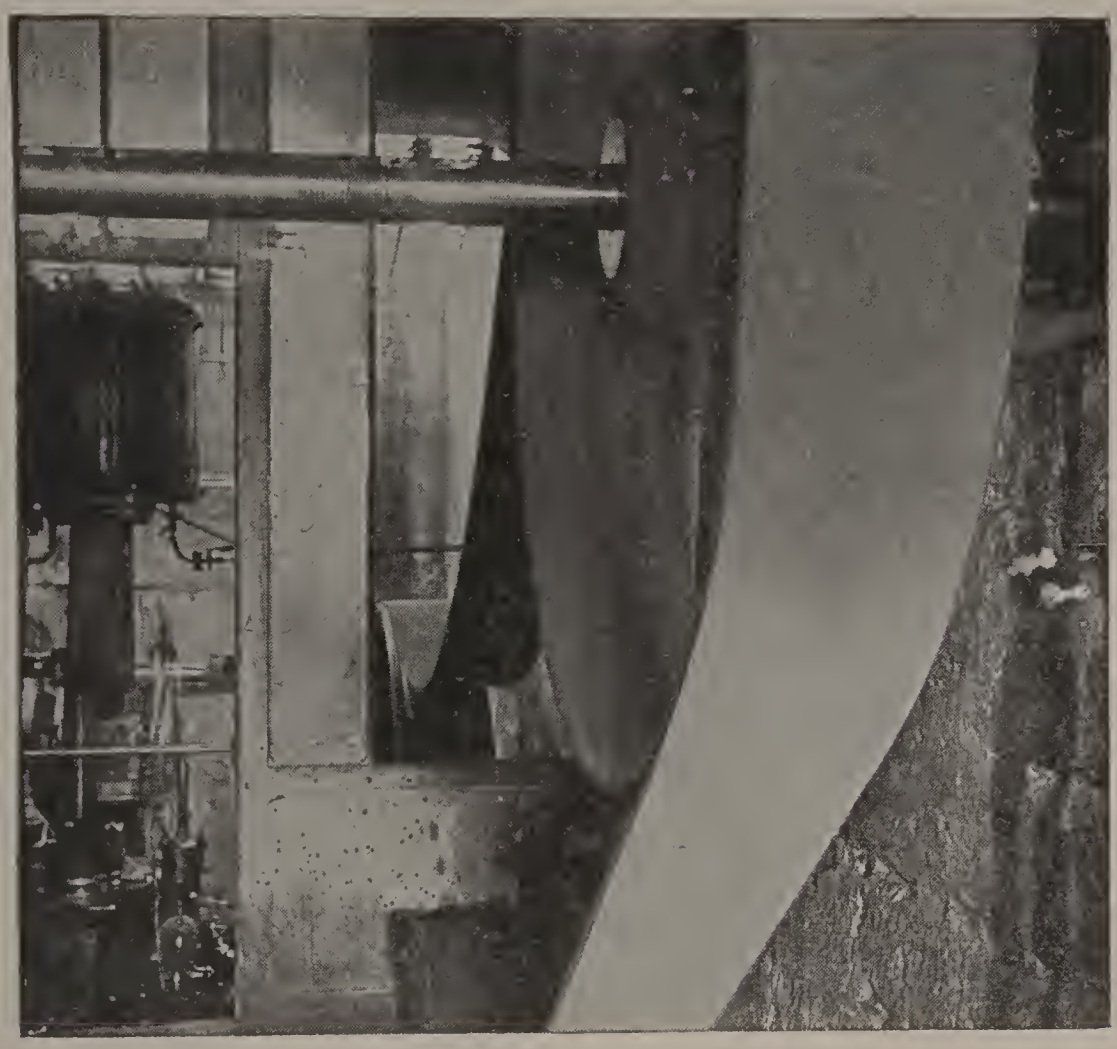
Initial tension only overloads the belts, bearings, shafting and engine



Cling-Surface-treated belt running slack in the works of Munz and Co., Stuttgart, Germany.

DriveR pulley, 4-foot, and driveN pulley, 3-foot 6-inch diameter. Distance between shaft centers, 14 feet.

9-inch Cling-Surface-treated double-leather gas-engine belt transmitting 65 horse power for Wright & Rowland, Birmingham, England. Without Cling-Surface this belt could be run only under great tension. As treated, it runs slack without slip or lash, thus relieving strain on bearings and increasing life of all parts of drive. Although slack when at rest, this belt easily takes starting load. 5000 feet of Cling-Surface-treated belting in this plant.



DriveR pulley, 3-meter (9.15-foot) diameter, 63 revolutions per minute. DriveN pulley, 2.30 meter (8-foot) diameter. Distance between pulley centers, 5.90 meters (19.3 feet). Belt speed, 1810 feet per minute.

This 10-inch cotton belt in the mill of Mangeot Freres, St. Maurice, France, transmits 70 horse power, runs with 48 inches of slack under Cling-Surface treatment, and gives complete satisfaction. All belts in both mills of this firm are treated with Cling-Surface.

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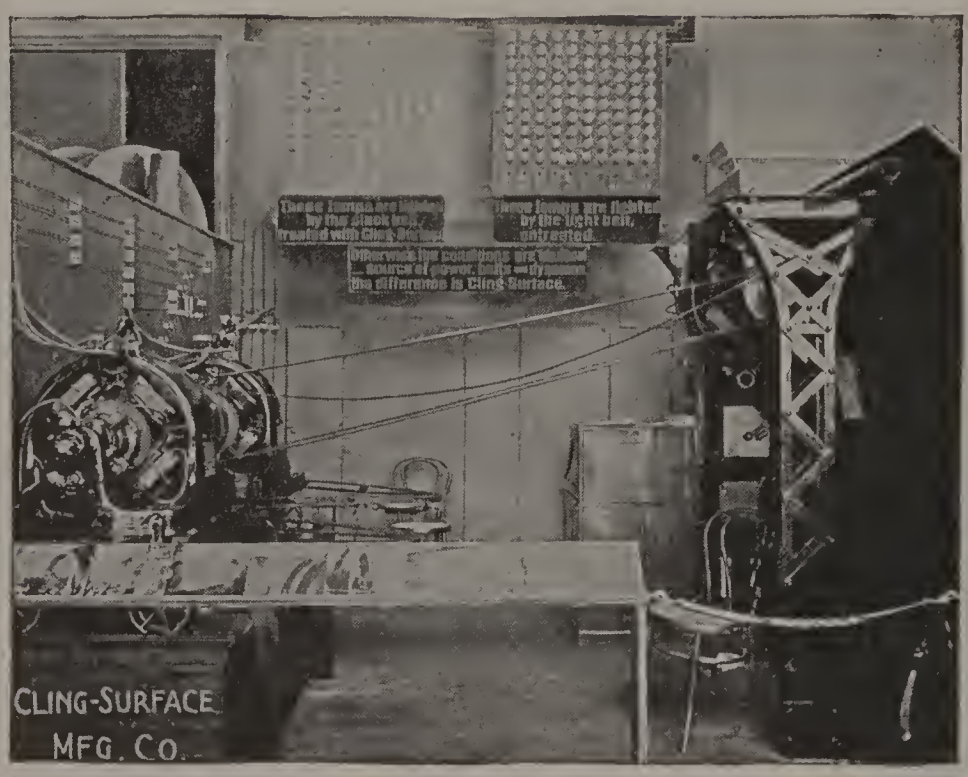
and in addition to increasing fuel and lubrication expense, is at the bottom of almost all belt trouble. This tension is the final burden that stretches the belt, destroys its natural elasticity, heats the bearings, melts the babbitt, pulls the shafting out of line, keeps the oil from reaching the bearing surfaces in sufficient quantity and makes much waste all the way from the engine and coal pile to the smallest belt in the plant. The total loss throughout the whole transmission line is enormous, and even under the most careful vigilance, tight belts involve a greatly increased power consumption. 45 pounds per inch of width is a common initial tension for single belts and from 60 to 80 pounds (Mr. F. W. Taylor says 71 pounds) is a conservative figure for heavier belts. On a 10-inch double belt, for instance, 10x70 (pounds) = 700 pounds. This being for one belt only, imagine the friction load from an entire shop full of tight belts!

Prof. Thurston says in his book "Friction and Lost Work" that the power loss in mills and shops ranges from 5 to 70 per cent. Undoubtedly this loss is very largely dependent upon the physical condition of the belting. Mr. Henry D. Jackson states in *Power:*



A test which offers simple proof of the possibilities of Cling-Surface treatment.

The 10-horse-power Westinghouse motor at the right in the picture is driving two 5-horse-power Westinghouse generators mounted on movable tracks attached to spring balances which in turn are arranged to show the initial and working tensions within the belts. The motor pulley is double and in one piece, and carries two 4-inch double leather belts on 8-foot centers. The belts are identical, being purchased from stock and from the same roll, but one is treated with Cling-Surface, while the other runs just as it came from the maker.

As this apparatus was exhibited at the Pan-American Exposition, the belt treated with Cling-Surface was under an initial tension strain of 50 pounds and when loaded it ran so slack that the top side barely cleared the lower or driving side.

The untreated belt was under an initial strain of 150 pounds and ran tight on both sides.

The output of the generators was delivered by wiring in plain view to two banks of 10-candle-power incandescent lamps, each bank mounting 100 lamps. Each dynamo was equipped with a field rheostat and a double throw switch for connecting it with either bank of lights. Each circuit had a separate voltmeter and watt-meter, by means of which the voltage generated and power transmitted could be directly compared.

Many combinations of tests were therefore possible. In detail the results of some of these were as follows:

With belts running under described conditions and with rheostats equal, the slack belt lit its 100 lamps brilliantly while the tight belt would only light its 100 lamps a faint red.

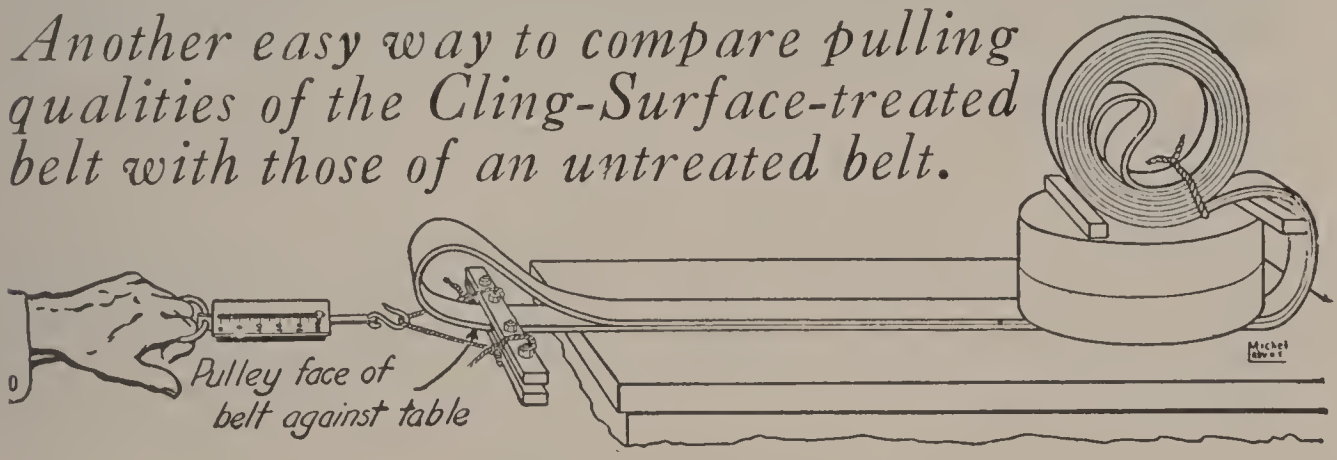
Only 20 lamps could be lighted by the untreated belt to a brilliancy equaling the 100 lamps of the slack belt.

Reducing the initial tension on the treated belt until the two sides of the belt touched made no variation in the light but did increase the transmitting capacity of the belt, while a reduction of the initial tension on the tight belt instantly showed a corresponding reduction in the light of its lamps.

The delivered power of the treated belt, as shown by voltmeter, averaged 110 volts, while the untreated belt, receiving power from the same pulley, delivered from 80 to 90 volts.

The speed of the generators averaged 400 revolutions when driven by the slack belt and 300 to 330 revolutions in the other case.

Another easy way to compare pulling qualities of the Cling-Surface-treated belt with those of an untreated belt.



A good smooth clean surface and belts that have seen equal service should be selected. The belts should be placed contact side down and the surface of the weight in contact with the belt perfectly flat. Although the treated belt has just as clean a surface as the untreated, an astonishing increase in pull will be required to make the treated belt slip.

> "In a number of plants that have been tested, both old and new, the friction load has been considerably in excess of 50 per cent of the total power generated by the engine. In machine shops it frequently runs as high as 75 per cent."

The *Southern Engineer* published this practical example in their January, 1913, issue:

> "A manufacturing plant of 250 horse-power nominal rating required an average of 268 horse-power for ten hours a day. The establishment had been run for some fourteen or fifteen months

without any trouble from hot bearings. Friction losses were naturally supposed to have reached the lowest possible figure.

"The question was raised as to the actual losses due to tight and stiff belts. This led to the application of the indicator when all the belts were on and when all but the main driving belt had been thrown off. The horse-power obtained with the belts on was 126 horse-power or 47 per cent of the total average power required, and 62 horse-power or 23.1 per cent with all but the driving belts removed. The loss due to the belts was practically 24 per cent.

"The shafting was lined, bearings cleaned and the belts rendered more pliable and run as slack as practicable. The indicator then showed that 96 horse-power was required, the shafting alone requiring 52 horse-power or 19.4 per cent and the belts 44 horse-power or 16.4 per cent. This is not an extreme case, yet the saving is worth while. If the engine required 34 pounds of steam per horse-power hour and 8 pounds of steam were obtained with a pound of coal, it would mean a saving of 1,139 pounds of coal in ten hours. At $3 a ton for coal this means a saving of $1.79 a day, which probably would equal the fireman's wages.

"To the casual observer there had been no unnecessary friction. Everything ran smoothly, cool, and apparently with little power. Yet, $1.79 a day or $537.00 a year was being wasted. It is evident, no doubt, that hot bearings indicate excessive and unnecessary friction, and that the absence of hot bearings does *not* indicate the absence of unnecessary friction."

The following table of power costs was compiled on the assumption of 4 pounds of coal per horse-power hour, 300 working days per year, ten running hours per day, and a coal cost of $3.00 per ton.

Horse-Power of Plant	Per Cent Saving in Power.				
	10%	20%	30%	40%	40%
50	$ 90	$ 180	$ 270	$ 360	$ 450
100	$ 180	$ 360	$ 540	$ 720	$ 900
200	$ 360	$ 720	$1080	$1440	$1800
300	$ 540	$1080	$1620	$2160	$2700
400	$ 720	$1440	$2160	$2880	$3600
500	$ 900	$1800	$2700	$3600	$4500
1000	$1800	$3600	$5400	$7200	$9000

If in a 200-horse-power plant operated with tight, untreated belts and friction load of 40 per cent, which is a common figure, treatment of the belting with Cling-Surface will permit slack or easy running and will reduce the friction load possibly to 20 per cent, such a power saving of 20 per cent, according to the table, amounts to $720 per year. Isn't that worth while, especially in view of the low cost for Cling-Surface treatment?

The exact cost of Cling-Surface treatment depends altogether upon the existing conditions and the condition of the belt at the time the treatment is begun. While some belts absorb more than others, constant application

DriveR pulley, 14-foot, and driveN, 30-inch diameter. Distance between shaft centers, 30 feet.

Ninety cents per year for Cling-Surface treatment of this 10-inch belt has enabled the Aird-Don Co., Troy, N. Y., to obtain 40 horse power continuously, without slip, trouble or loss. Treatment once a month during the last three years has made the belt very pliable, and no belt in this entire plant has been tightened since Cling-Surface treatment was started.

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until the desired end is reached is never expensive. The costs mentioned in connection with illustration above and on pages 9 and 70 indicate a fair average.

The application of Cling-Surface

Each package of Cling-Surface has upon it a label giving short directions for its use. These directions will usually be found ample, as the treatment of ordinary belting under average conditions is extremely simple. The subject is, however, more thoroughly covered in the following pages, to give every belt man ready reference and the best methods of procedure for all possible extraordinary as well as all simple conditions. For convenience, we have paragraphed each condition under special heading. It should be noted that this chapter refers only to *ordinary flat leather* belts. Those of other construction or fabric are dealt with in later chapters. Anyone who follows the advice given should obtain results eminently satisfactory.

Systematic application essential

Cling-Surface is not merely a temporary preventive for belt slip — a medicine for sick belts. True, it does offer speedy relief in all aggravated cases, but when its use is so restricted two-thirds of the benefits are lost. Nor is Cling-Surface a "belt dressing" in the usual sense of that term. The full value and possibilities of Cling-Surface treatment are obtained only by intelligent, systematic application to *all* the belts and the establishing of the slack belt system throughout the plant. A belt once filled will need only a little Cling-Surface at intervals thereafter to refresh the face.

It is well first to treat and fill three or four belts, note the effects and then extend the treatment. Some form of record and mechanical reminder can be used if desired, in keeping track of the applications to each belt and to serve notice as to when the next application should be made. Such a "tickler system" can be kept, to give a complete history of the belt in service, including cost of maintenance. It will be found too, where the treatment of belting with Cling-Surface is put into the hands of one or more competent men as their special work, that belt troubles largely vanish; it will also be found that the belts are all pulling the maximum loads and that irregularities and machine shutdowns, due to belt slip and breakage, are almost unknown.

To a man accustomed to the trivial effects from belt dressings, many of these far-reaching results are sometimes either not realized, or not at once attributed to Cling-Surface, but for the man who can realize the possibilities, before or after starting the treatment, and who will work for them, thereby securing relief for himself from the strain and trouble of poor belt service and at the same time giving his works the best possible service with greatest output and least attending expense—Cling-Surface will make good every time.

Cling-Surface must be applied hot

Cling-Surface should never be applied cold. The best and quickest results are obtained by heating to about the consistency of cylinder oil, which may be accomplished by keeping some in a pot or can on the steam chest or cylinder head of an engine. Heating over a gas jet is also practical, as Cling-Surface is no more inflammable than butter or lard. Boiling is neither necessary nor advisable; in fact, should be prevented, because boiling thickens any grease.

Cleanliness is imperative

Cling-Surface should be handled just as carefully as lubricating oil. It should never be put into a dirty or oily tin or kettle, nor should it be applied with an old brush containing dried paint or varnish.

Cling-Surface does not evaporate nor dry on the surface, but stays just as it comes. However, it should be kept covered, especially while being heated, to keep out ashes and dust.

Best methods of application

All belts can be treated with Cling-Surface in either or both of two ways. Some prefer one and some the other.

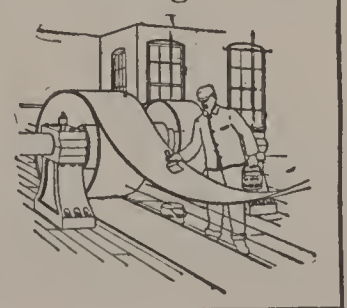
One method is to use a new or clean paint brush. By dipping the brush into the hot Cling-Surface, *rubbing off the excess on the side of the can* and working the brush across the face of the belt, a very thin film can be applied and excess in spots avoided. Care should of course be exercised to prevent the brush from being jerked from the hand. The Cling-Surface may also be applied while the belt is stopped, but this is apt to lead to too heavy an application.

The other way is to keep the Cling-Surface supply in an enameled teapot and pour it in a fine needle-like stream zigzag back and forth across the face of the belt. In this instance the Cling-Surface should be poured two feet from the pulley ahead or on vertical belts, on the lower pulley, so the pulley will spread it while hot. The teapot method is handy because the Cling-Surface can easily be kept hot and carried about, but there is greater tendency to apply too much Cling-Surface by this than by the brush method. Some engineers therefore flatten the end of the spout to assist in assuring a fine stream and avoiding an overdose.

With either method, the face of the far pulley should be watched and the application stopped when the brown stain of the Cling-Surface reaches that indicated on the guide (see inside front cover). Porous belts will absorb more Cling-Surface than will non-porous ones, but the stain as a guide should not be exceeded.

As a rule Cling-Surface can be best applied to the inside face while the belt is running slowly and under light load. By using care, however, and applying in the very light applications as directed, a belt can be so treated any time. A good way to work the Cling-Surface in and help fill a belt quickly is to apply when running on the loose pulley.

Painting back of belt with Cling-Surface



The outer or back side of the belt should also be treated by the brush method, which can be done

while the belt is idle or better, running, while the belt passes over the smaller pulley. In either instance, the Cling-Surface should be *applied hot. This back treatment is important*, because the back of a belt gets the most strain and must be pliable to bend around the pulleys. A thick coat of Cling-Surface on the back of the belt at all times is not necessary, but Cling-Surface should be fed steadily to the belt through the back as fast as the Cling-Surface is taken in.

Frequency of Cling-Surface application

Most engineers treat oak-tanned belts every other day, at first, though some can do it daily, for two or three weeks, to get them filled quickly. Some apply the Cling-Surface more carefully and in *very* small amounts twice daily for the first week. In any case the application should *never* be repeated until the stain has not only all disappeared from the pulley but *until the belt has absorbed all the last Cling-Surface applied.*

The exact frequency of Cling-Surface applications depends on how much is applied at once and upon the belt itself, for some belts absorb more quickly than others. Too much will cause temporary slip, so it is better to use too little and do it oftener than too much at longer intervals. The application should be repeated only *after* the previous coat has penetrated. After the first two weeks, the intervals can be extended, for, as a belt becomes more and more nearly filled, it will absorb less and less rapidly. The interval between applications should be lengthened accordingly until once in four to six weeks may be enough to keep the face refreshed.

If any lumps gather on the pulleys, either Cling-Surface is cleaning dirt or old dressings off the belt or the Cling-Surface is being applied too fast or too freely or too cold. The lumps are dirt, dust and excess Cling-Surface, and if cleaned off as they form and the treatment properly regulated, the trouble will quickly disappear. Cling-Surface alone won't harden into lumps on the pulleys any more than it does in the package. (See Cleaning Belts, page 35.)

Treating new belts with Cling-Surface

New leather, unpainted canvas and hair belts can be treated with Cling-Surface before being put onto the pulleys and usually run better by so doing.

A new belt should be washed with cleaning mixture (page 35) to remove tanner's wax. The front and back may then be painted quite liberally with hot Cling-Surface, after which the belt should be hung up in the sun, boiler room or some other place where the heat will cause penetration of the Cling-Surface. This process may be repeated several times, any unabsorbed excess of Cling-Surface wiped off, and the belt rolled up and put in the storeroom for cutting off into lengths as needed.

Incidentally, the belt stock should not be in a damp place nor in a very dry one, and should be kept off the floor. A very convenient belt rack is made by suspending iron pipe in convenient notched frames, the iron going through the center of the roll of belting, enabling the belting to be pulled out (unwound) to any desired length.

In buying a belt it is advisable to get it from a reliable firm and to make sure that it has a close fiber and is very pliable.

Cleaning old belts preparatory to Cling-Surface treatment

Some men think it a hardship to have to clean belts, but the improved service derived from any cleaned belt will many times repay the small effort. Cleaning is not absolutely necessary any more than is cleaning of shoes before polishing, but Cling-Surface on top of dirt or belt dressings cannot be expected to do its best work or produce the right results. In every instance the face to be treated should at least be lightly wiped or dusted off before applications are made.

Clean belt before applying Cling-Surface.

The best way to clean a *leather* belt is to wash well or scrub with a brush with a cleaning mixture composed of two parts gasoline or naphtha or petrol and one part turpentine. Note we emphasize leather, for the use of gasoline, naphtha and the like is not practical on *rubber*, or *balata* belts. 76 per cent specific gravity naphtha or gasoline should be used, as low grades, like painter's naphtha, contain oil and leave the belt greasy. The softened dirt can then be scraped off with an old file or dull knife. This washing and cleaning should be repeated until bare clean leather is reached. The belt should then be *dried* before it is ready for commencing treatment with Cling-Surface.

The cleaning mixture gives the best and quickest results. However, any form of belt may be cleaned by applying a few treatments of hot Cling-Surface to soften up the dirt, then scraping the dirt off as shown. The softened dirt may roll up on the pulleys or come off in rolls or flakes looking like pieces of thin black leather. These should be removed, and the loosened dirt scraped off, taking care not to scrape hard enough to injure the belt surface.

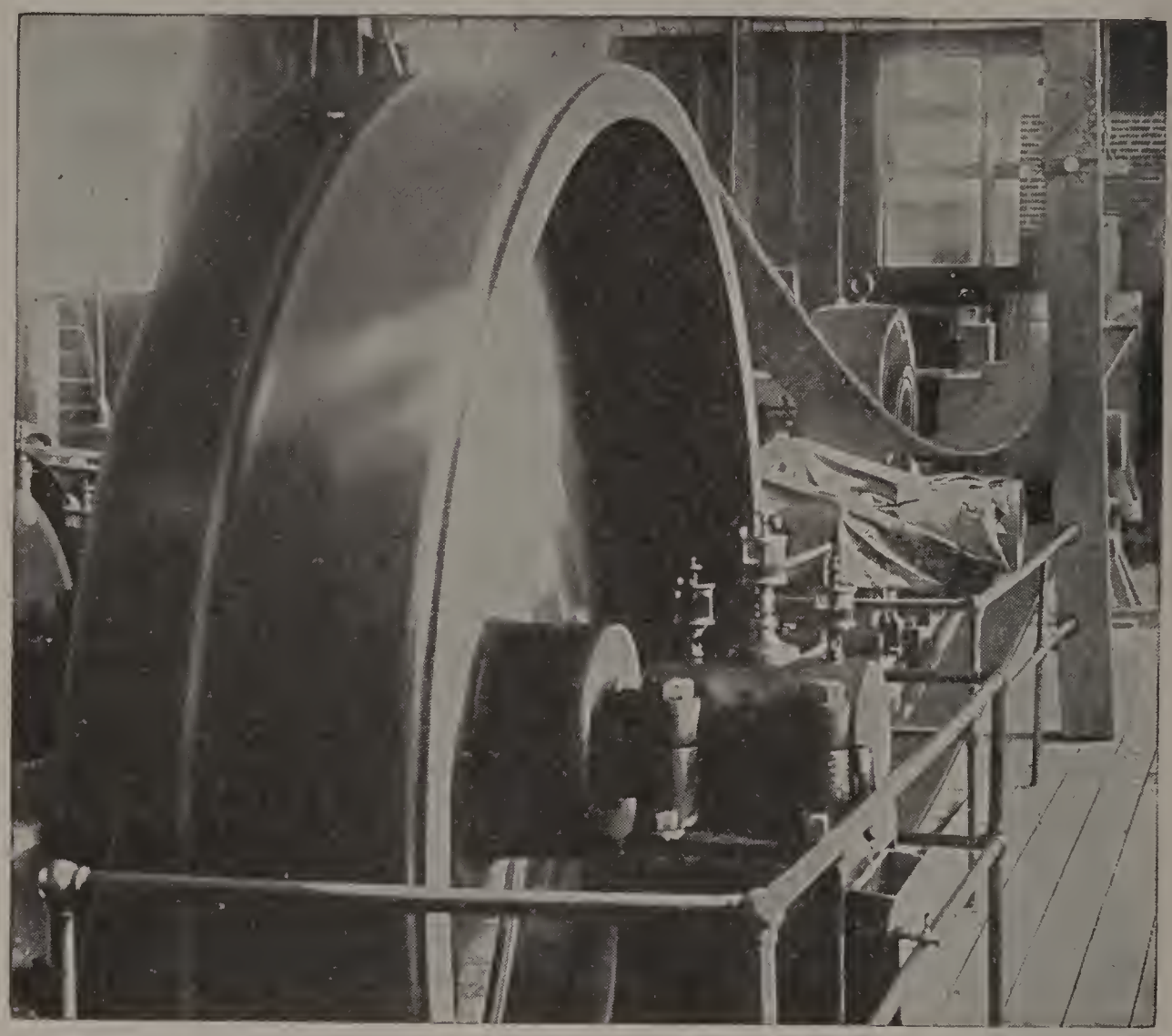
Another way is to have a round tank with a cover and a drip near the bottom, and large enough to accommodate the belts used and deep enough to cover them when raised a little off the bottom. The tank can be nearly filled with the mixture and the belts put in in a loose roll and allowed to soak for several hours or over night. The belts may then be squeezed between rollers or a press, if desired, to force out all the grease, and finished as before mentioned.

Inasmuch as naphtha and gasoline are highly inflammable, the cleaning mixture and the fume-laden belt after removal therefrom should be kept at least 200 feet away from any fire. If the tank method is used, it is advisable to keep the tank covered to prevent evaporation.

Treatment of oily belts

The effect of oil which has leaked from bearings and permeated the belts can be overcome by Cling-Surface treatment. Belts should, however, be protected from this oil spatter or leak, for success cannot be expected when the cause of the trouble continues.

The belt should be washed with the cleaning mixture or with either gasoline, naphtha or even turpentine alone. Next the face of the belt should be covered with fuller's earth, powdered chalk or some other dry absorbent powder and left on over night or as long as possible. This covering will



An old dirty oil-soaked 12-inch leather belt bought second-hand for construction purposes and found to be good for 120 horse power when run tight. When photographed it had been treated with Cling-Surface and was doing 180 horse power easily. Preparatory to Cling-Surface treatment, over 30 pounds of black grease and dirt were removed. Cling-Surface forced the oil through the back like sweat, and when a year's hard work in an open shed was completed, the belt was resold in better condition than it had been bought.

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absorb much of the oil and the mixture may be scraped off with an old file or dull knife.

A subsequent washing with the cleaning mixture will usually remove most of the oil from the surface fibers and Cling-Surface will do the rest. Sometimes a second powdering, scraping and washing is necessary.

Cling-Surface should then be carefully applied to the inner belt face, using a little less than for a similar dry belt and repeating as directed for ordinary treatments. The outside of any oil-soaked belt, except those treated with castor oil, should not be painted at any time. These pores should be left open so that Cling-Surface, being a heavier grease than that in the belt, will force the oil out through the back. It may be noted oozing out there like perspiration. This should be wiped off as it appears, until as Cling-Surface penetrates through the belt, the oil is gradually and completely forced out.

Leather, plain cotton or hair belts which have been "dressed" with castor oil should be very well washed with the cleaning mixture (page 35), for castor oil is very gummy and the gum all remains in the belt. Such belts should be treated very carefully because the gum hinders penetration and too much Cling-Surface causes slip.

Cling-Surface does not affect belt-cement

Cling-Surface neither strengthens nor weakens the cement in the belt lap. The greater work that Cling-Surface makes a belt do may cause an old and weak joint to pull apart, but that simply proves that the belt is exerting a strong pull where it was shirking before.

In re-cementing belts treated with Cling-Surface, the faces to be joined should be thoroughly washed off with naphtha or benzine, and allowed to dry. The glue can then be applied in the usual way.

Treating small round belts

Small round belts may best be treated by painting with, or dipping in, hot Cling-Surface, then hanging up over a steam pipe in the boiler room, first covering the pipe to prevent burning. After the Cling-Surface has penetrated, a second treatment is often desirable. Any excess of Cling-Surface left outside the belt should be wiped off before putting on the pulleys.

Round belts so treated will be made pliable, will slip less or none at all, will last longer and will be less apt to break. If they do break, they will usually stretch enough to be relaced.

This class of belts should usually be taken off to be treated so as to prevent getting excess Cling-Surface on the pulleys, and by having a few spare belts ready, the removal will cause no service interruption. All the belts can thus be kept in good condition all the time.

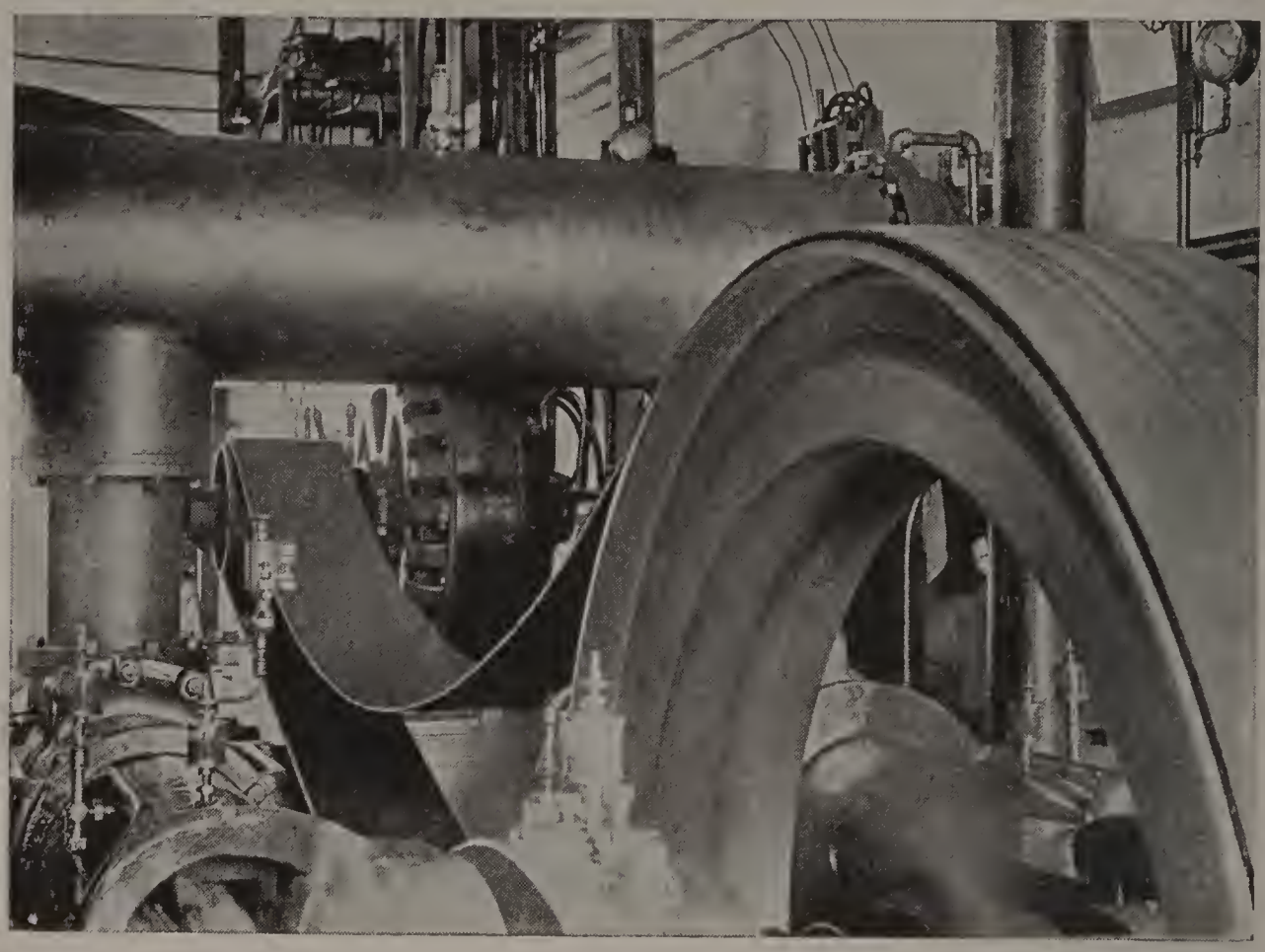
Treating chrome and orange-tanned leather and rawhide

These do not absorb Cling-Surface so fast as ordinary oak-tanned leather and therefore must be treated more cautiously. The Cling-Surface must be applied in lighter doses, limiting the stain on pulley face to that shown for balata. (See inside front cover.) The application may be made daily, or every other day, for first week, being guided by the rapidity with which the belt absorbs the Cling-Surface which has already been applied.

The back also should be painted more lightly and succeeding applications should never be made while any Cling-Surface shows from previous application. These belts take longer to fill, but gradually become permanently pliable and supple, and will then do their best work.

Treating laminated belts

The treatment is the same as for oak-tanned leather, except that a second and third application can be made on the outer side at shorter intervals, as the formation of the belt allows the hot Cling-Surface to work in between the strips of leather, and more quickly complete the filling than with ordinary leather.



DriveR pulley, 14-inch diameter, 765 revolutions per minute. DriveN pulley, 5-foot diameter. Distance between shaft centers, 13 feet. Belt speed, 2800 feet per minute.

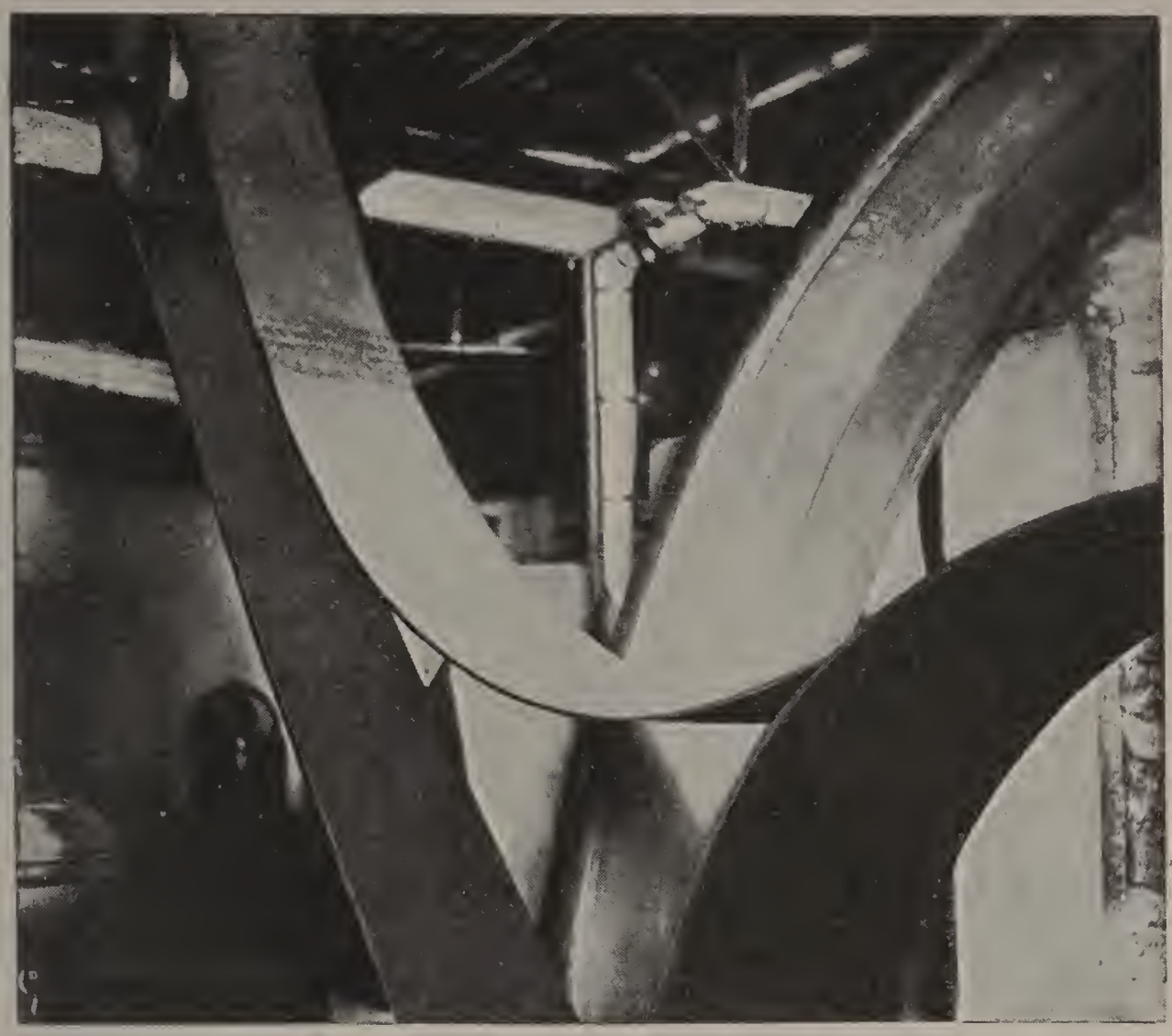
A 12-inch laminated belt driving an air compressor in John Bertram & Sons plant (also the Canadian plant of Pratt & Whitney). Although the variation of load, sometimes sudden, between 25 and 82 horse power makes this a severe test for Cling-Surface treatment, the belt had run for two years with 24 inches of sag under full load without slipping.

Treating leather link or chain belts

These should be treated by the brush method, on the back only and while idle. The application should not be heavy enough to cause the Cling-Surface to run through onto the pulley, for this would cause slip until the Cling-Surface was absorbed or wiped off. If the treatment is applied immediately before starting the belt, the hot Cling-Surface will work its way down into every part. A *light* painting twice a week for the first month will be enough for the initial treatments and later applications can be made at longer intervals, depending upon the suppleness and condition of the belt. Cling-Surface is especially beneficial on belts of this type in that it lubricates the bearings, prevents the belts from getting dry and out of shape and reduces the rattle which they sometimes make.

Getting the belts slack for full benefits from Cling-Surface treatment

The prevention of slip, with consequent increase of power transmitted, as accomplished by Cling-Surface treatment, causes nearly all belts to stretch



DriveR pulley, 5-foot diameter, 82 revolutions per minute. DriveN pulley, 20-inch diameter. Distance between shaft centers, 11 feet 4 inches. Belt speed, 1288 feet per minute.

Main belt, Southam Printing & Lithographing Co., London, Canada. An 18-inch splice (faintly visible) was added to this 12-inch leather belt to obtain the slack of 3 feet and to make the increased pulley wrap practical. The photograph was taken 2½ years after starting Cling-Surface treatment and the belt was in most desirable condition. *(See also illustration on page 18.)*

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under this strain up to the extent of the extra load. Often this or the natural stretch of a new belt under load will slacken the belt sufficiently so that no artificial slackening is needed.

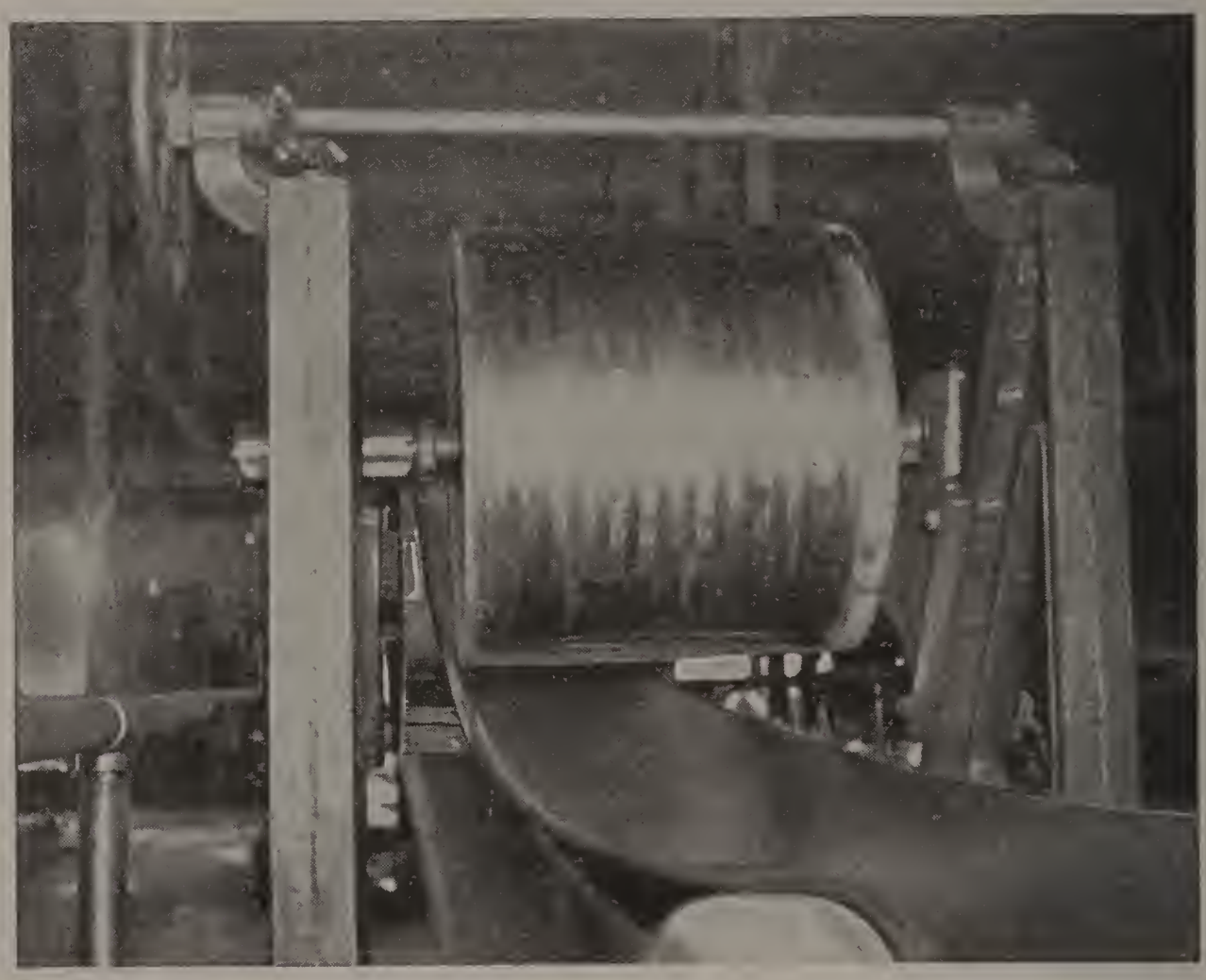
However, if this is not the case, and the distance between shaft centers is fixed, a short length may be spliced into the belt. Such a splice should be treated with Cling-Surface as directed under New Belts (page 34) until it is like the belt itself.

A belt may be eased after a few applications of Cling-Surface, and after a few weeks' treatment should be capable of running thoroughly slack.

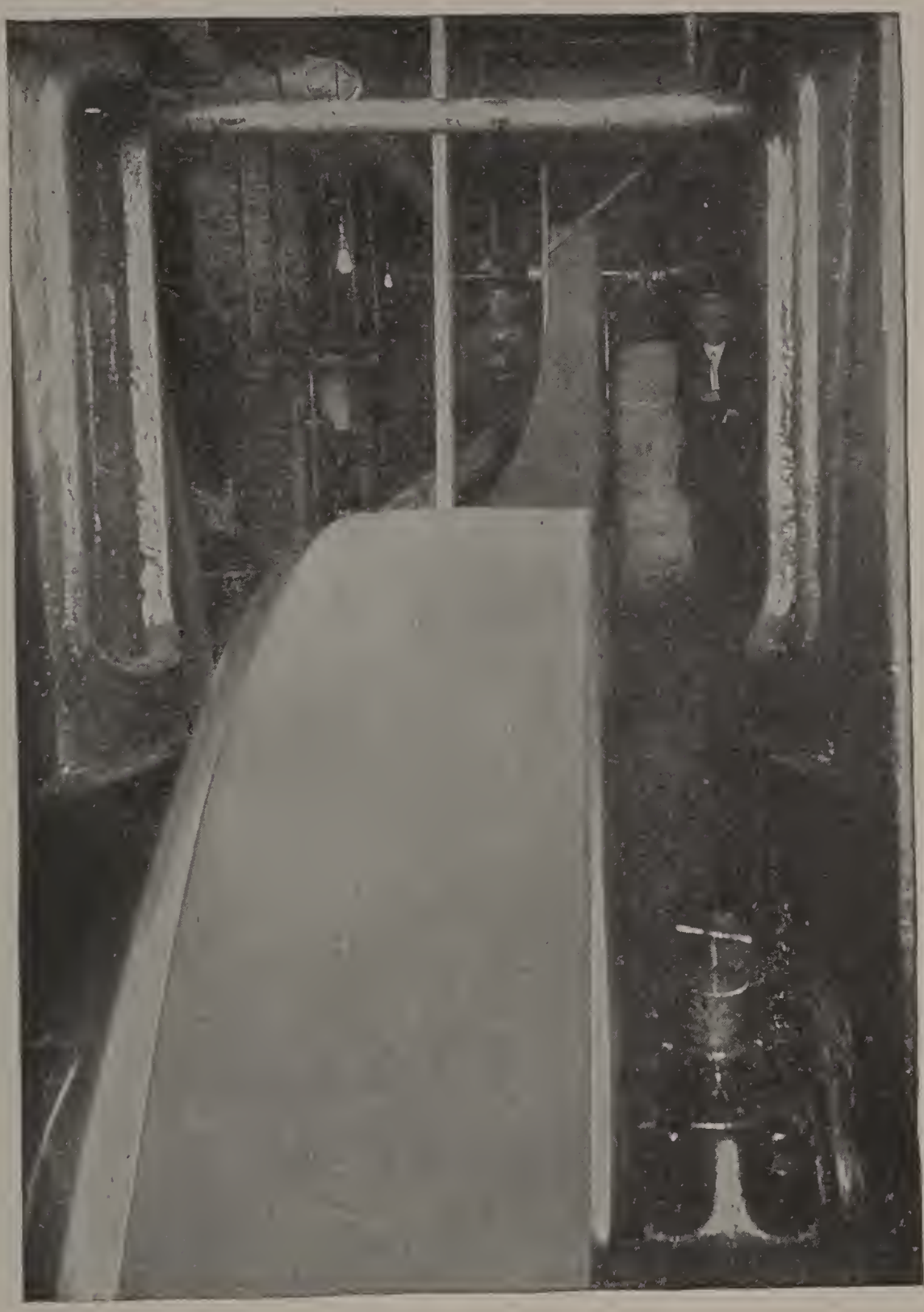
No tighteners needed after Cling-Surface treatment

Tighteners or idlers used to put tension on a belt are producers of enor-

Formerly an idler was used on this 6-inch leather belt to maintain pulley contact and keep the belt from hitting the beam on starting. Now with Cling-Surface treatment and a slight shift of driven pulley, the belt runs under beam, pulls 15 horse power and the idler has been dispensed with. Kutz Knitting Mills, Bechtelsville, Pa.



Old and oily 30-inch leather air-compressor belt, New York Aqueduct construction plant, Yonkers, N. Y. The 1000-pound tightener did not prevent slip. Since starting Cling-Surface treatment here over a year ago the tightener has not been used once, and the belt never slips although running with a sag of 13 inches.



Drive R pulley, 24-in., and drive N, 48-in. diameter. Distance between shaft centers, 20 feet.

A 4-ply Gandy belt treated with Cling-Surface since 1908. (Hygea Ice Co., Corning, N. Y.) This belt has never been taken up since put on the pulleys and when photographed was pulling 35 horse power and running with a sag of 30 inches. There is no slip and the belt fabric is impervious to moisture. This is typical of Cling-Surface treatment on painted canvas belts.

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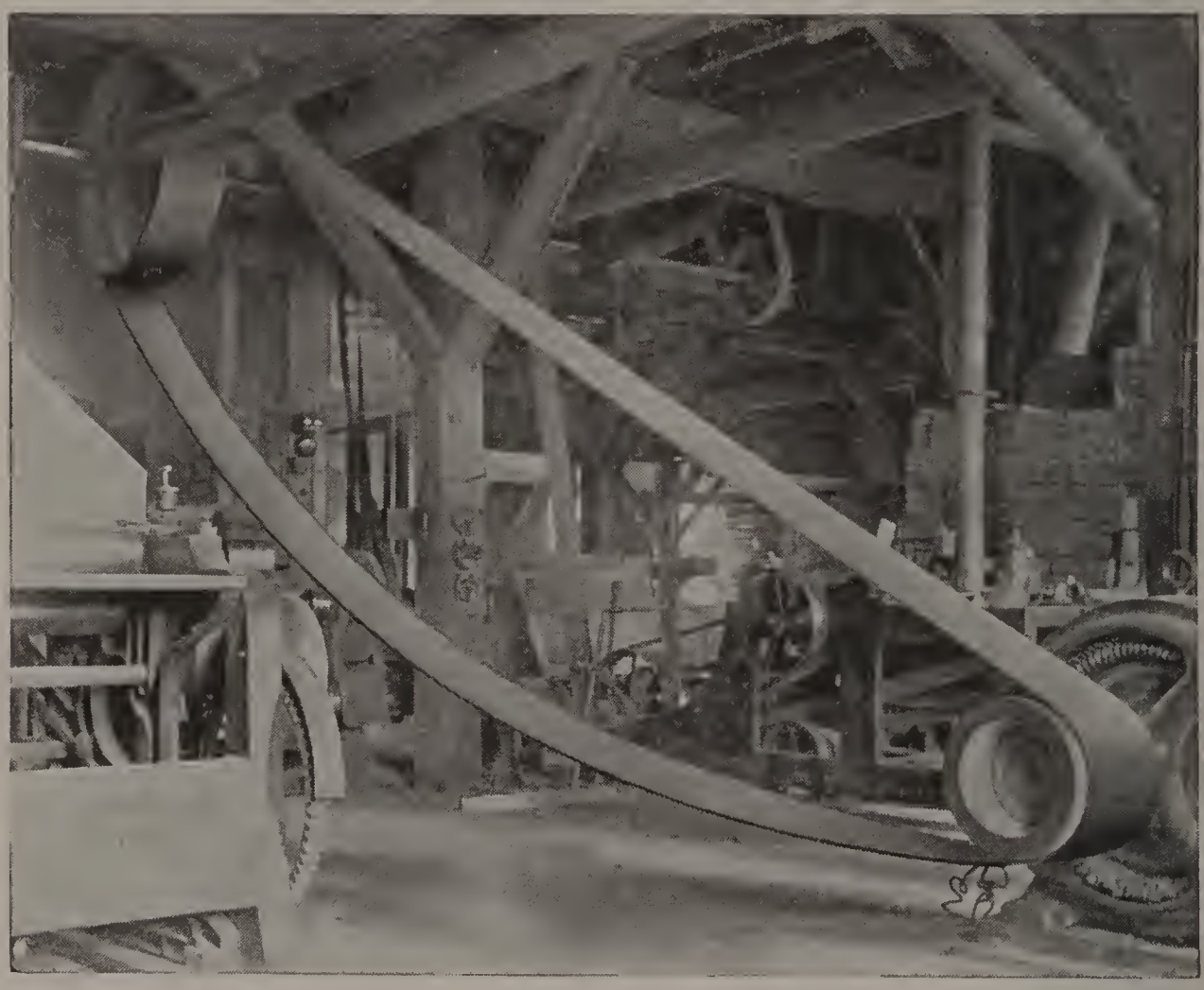
mous friction with corresponding power loss; they make lubrication costs greater and are a source of expense generally that should be removed at the earliest possible moment.

Cling-Surface treatment prevents slipping better than tighteners can and almost always makes tighteners unnecessary. (See cuts, pages 6 and 7.)

As a belt becomes filled with Cling-Surface the tightener can be gradually lifted off. Idlers, trailers or guide pulleys are sometimes used even with slack belts (and raised tighteners act as such), not to increase the tension, but simply to either keep the belt close to a pulley in overdrives or to guard against any sudden lashing under uneven loads. These, of course, are not objectionable, but Cling-Surface effects decided economies even in these instances. Such guide pulleys should usually be applied near the driven pulley and arranged for adjustment, as the least up or down movement will make a great difference in the position of the belt on the driven pulley while running.



DriveR pulley, 14-inch diameter, 850 revolutions per minute. DriveN pulley, 40-inch diameter. Belt speed, 3110 feet per minute.

Showing the possibilities of Cling-Surface treatment on overdrive and old belting. This 10-inch painted canvas belt in the furniture factory of the Richford (Vt.) Mfg. Co., had been discarded as no good, but was put back into service during an emergency. When the motor was first started, this belt wouldn't carry the friction load, but under Cling-Surface treatment it transmitted about 60 horse power with a sag of 23 inches from a direct line between the pulleys and it has at times carried 85 horse power with even more sag. When idle the bottom can be raised to touch the top side.

Old or weak belts

Naturally a belt which cannot carry its load will break if it cannot slip. Cling-Surface will prevent slip so completely that an old belt too weak for an increased load may break, or laces or fasteners may give away, especially if the load is thrown on too suddenly. Even a good new belt can be quickly ruined by starting under full load as is sometimes thoughtlessly done, and too much care cannot be exercised in this regard. It must be remembered, however, that although Cling-Surface will make a belt transmit a higher percentage of power than it ever has before, no belt, either with or without Cling-Surface, should be too light or too narrow for its load.

Motor and generator belts

Variation of load, absolute dependability, power economy, minimized attention and a smooth steady output are factors which are exceedingly important with this class of belts.

Inasmuch as belted motors and generators are usually mounted on sliding frames and provided with adjusting screws, they can be made to show quick evidence of the advantages of Cling-Surface treatment and the slack belt practice. The slip, burning of belts, the hot boxes and attendant annoyances, often resulting from attempts to compel belts to pull peak loads under high tension, begin to disappear with the first Cling-Surface application. With a dynamo belt of proper construction, flickering of lights due to belt slip will entirely disappear as will all the annoyance of static electricity within the belt. The belt and the bearings can be eased as previously explained and the service is bound to be improved.

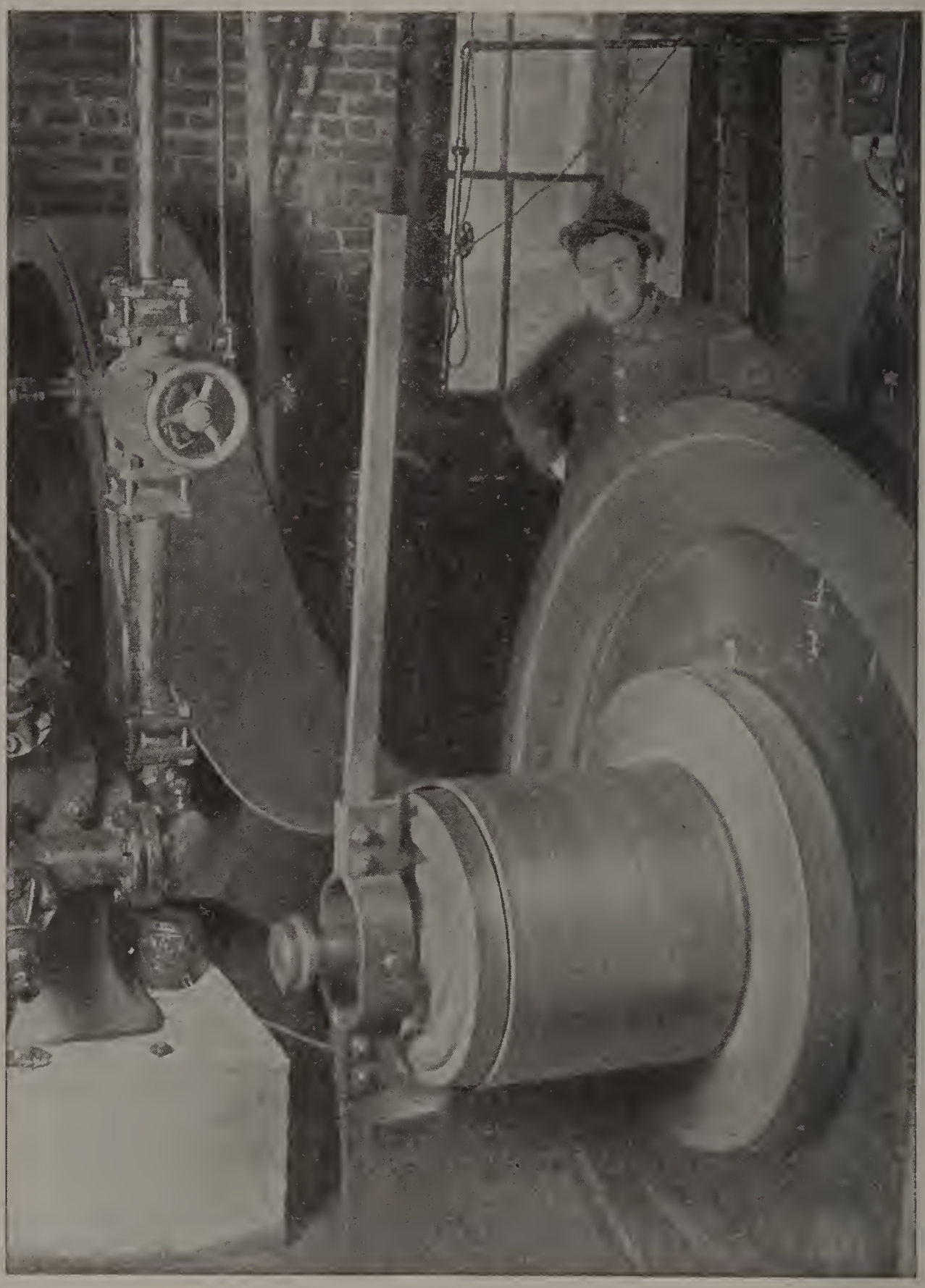
Belts coming off

Belts usually run off because they slip. Cling-Surface treatment prevents the slip, so a belt with Cling-Surface stays on the pulleys if they are in line. Sometimes a heated bearing will so increase the load that the belt slips off, but hot bearings are rare with slack or easy belts. Too much Cling-Surface carelessly applied at one time may temporarily cause a belt to slip off until the excess Cling-Surface has been absorbed or removed. Such a belt will stay on as soon as the excess is wiped off.

Fluctuating belts

Flapping up and down, waving, twisting, swaying back and forth horizontally and twisting corkscrew-like are all conditions detrimental to good belt service and which may become a serious menace where the belt has enough motion to cause it to leave the pulleys. There is usually a definite cause for such trouble, which can be located and corrected.

Insecure foundations, loose shafting, side play in the bearings and bad pulley alignment are often the cause. All belted machines should have good foundations, be securely bolted to them and have the shafting of driving and driven pulleys perfectly parallel. The pulleys should be truly round and have the crown exactly in the center all the way around, for an imperfection in either of these respects will make a belt wave and flap very noticeably if the belt is run slack. It is also imperative that the edges of a laced joint are exactly at right angles to the edges of the belt, that the joint is laced true to prevent one side from being a little longer than the other, and that



DriveR pulley, 16-inch and driveN, 72-inch diameter. Distance between shaft centers, 9 feet 2 inches. Belt speed, 1140 feet per minute.

A 14-inch double leather belt transmitting 35 horse power on a gas-engine drive. This belt is heavy and large for the load, but even at that it would ordinarily have had to be run tight to prevent slip. Under Cling-Surface treatment it now runs with 24 inches of sag under heaviest load, but there is no slip.

no clumsy bunch of laces or belt hooks thump on the pulley with every contact. Metal fasteners, especially those running over small pulleys, cause the belt to rise or jump as the joint passes over the pulleys. One edge of a belt should not be stretched longer than the other, due to absorption of oil from a nearby bearing.

A common cause of flapping and waving is the character of power delivered to the belt, or the character of load the belt carries. A fluctuating delivery of power to or from the belt due to suddenly changing shop load may set up a corresponding fluctuation within the belt. The pulsating delivery of a gas engine or the irregular load from an air compressor, for instance, either in connection with other conditions or alone, often makes trouble of this kind. Another common cause is slipping. Belts slip a little under some peak loads, which causes a little wave to run along the slack side of the belt. When this hits the pulley, it gives a wave around the pulley, if the belt is not too tight, and this in turn causes greater slipping and so on until there is a decided fluctuation given to the belt.

Wherever flapping occurs, mechanical imperfections, as described, should be corrected if they exist. Subsequent treatment of the belt with Cling-Surface, by permitting better pulley contacts and by improving the power of transmission, will then steady the drive materially. A belt which has stretched irregularly is greatly benefited by Cling-Surface, because the Cling-Surface makes the tighter part carry more load until the pulling power of the whole area of the belt is equalized.

The Cling-Surface should be applied persistently in small amounts because any excess on the inner face of the belt tends to cause temporary slipping until it has penetrated. It is the Cling-Surface which *has* penetrated, *not* that lying on the outside, which stops the slipping.

Sometimes when Cling-Surface has had only a limited use, there are spots in the belt which, due to irregularities in the hide or to past burning, or the filler used, as in painted cotton belts, are denser than others and have not yet become so pliable. These will be stiff until they become pliable as more Cling-Surface is absorbed, but in the meantime they hit the pulley and tend to make the belt jump. Cling-Surface will cure this if its use is continued.

As the Cling-Surface treatment progresses, the belt may be slackened without danger of slip and with less and less tendency toward flapping.

However, where the load is off and on at short intervals, or for belts on gas engines, and with the intervals too quick to allow of the belt's recovering itself, it is advisable not to run too slack a belt, but to run simply easy, according to the work done. A *very* slack belt, though desirable, is not always advisable. All belts should be run as slack as possible, even though Cling-Surface treatment will enable more power to be delivered by a belt at extreme tension than it is possible to give through an untreated belt at the same tension.

Belts subjected to steam or moisture

The action of moisture upon belts is perhaps more destructive than any other influence, and unless a belt is rendered impervious to even the slightest surrounding moisture, stretching of the leather, crooked running and weakening of the cement between laps and plies are inevitable. Especially while a belt is idle, does water or moisture tend to penetrate, and in factories in warm damp climates, or when plants are unheated during rainy seasons,

DriveR pulley, 22-inch diameter, 234 revolutions per minute. DriveN pulley, wood, 30-inch. Distance between shaft centers, 10 ft. Belt speed, 1350 ft. per minute.

An 8-inch single leather belt transmitting 20 horse power in the plant of the Chicago Laundry Co. Before Cling-Surface treatment many dressings had been used, but the belt remained hard and kept the engineer busy all the time. To get even fair transmission, it had to be run so tight that several fillings of the oil cups on the engine were necessary every day. After Cling-Surface treatment, a sag of 20 inches was possible without slip, dampness never made trouble and the engine bearings stay cool with ONE filling of the oil cups per day.

DriveR pulley, 6-foot diameter. DriveN pulley, 20-inch diameter, 645 revolutions per minute. Distance between shaft centers, 25 feet. Belt speed, 3370 ft. per min.

Belted portable sawmill, Hoyt Bros., Ware, Mass. Dirt, dust, snow, water and sawdust get on this 14-inch double leather belt, but after three years of Cling-Surface treatment this belt still resists the elements perfectly. This firm took to Cling-Surface in 1901 to waterproof exposed belts and now states that Cling-Surface has also effected a noticeable saving in power, bearings and attention.

This belt, C. Barends' plantation, Tjarennang, Java, D. E. I., formerly made much trouble because of climatic changes. Damp nights and hot days affected the belt fabric too much for smooth running, but now, under Cling-Surface treatment, slack running is always practical. No slip, and belt is immune to the changes.

some protection for the belting is essential, to say nothing about the alteration in belt length due to weather changes. In textile mills, bleacheries, tanneries, laundries and the like, moisture interferes seriously with the belt service from unprotected belts. In tropical regions some belts have been known to change six inches in length in one day.

Cling-Surface treatment makes belts thoroughly impervious to moisture and steam and makes starting up and running as easy and satisfactory on wet as on dry days. Special expensive waterproof belts are not necessary, as Cling-Surface will waterproof any ordinary belts already in service. A cemented leather belt treated with Cling-Surface will resist all ordinary dampness and steamy conditions and even considerable submersion in water as in floods. A wet belt to be treated with Cling-Surface should first be dried out. This will open up the pores to let the Cling-Surface in and afterwards the applications can be continued and the belt kept filled in the ordinary manner. (See also illustration on page 70.)

Belts subjected to heat

Belts running in very dry or hot places as near a furnace or boiler, in brick works, etc., may dry out and crack quickly if not protected.

All such belts can be kept pliable and the danger of drying and cracking minimized by a filling of Cling-Surface.

The Cling-Surface should be painted liberally on the back of the belt and the applications repeated as fast as the Cling-Surface penetrates, until the belt is thoroughly filled. After the belt is filled, further occasional applications are desirable, because the heat makes a belt demand more food than in ordinary places. Applications to the belt face in this instance should be lighter at a time than usual elsewhere.

Belts in dusty surroundings. Lumping on pulleys.

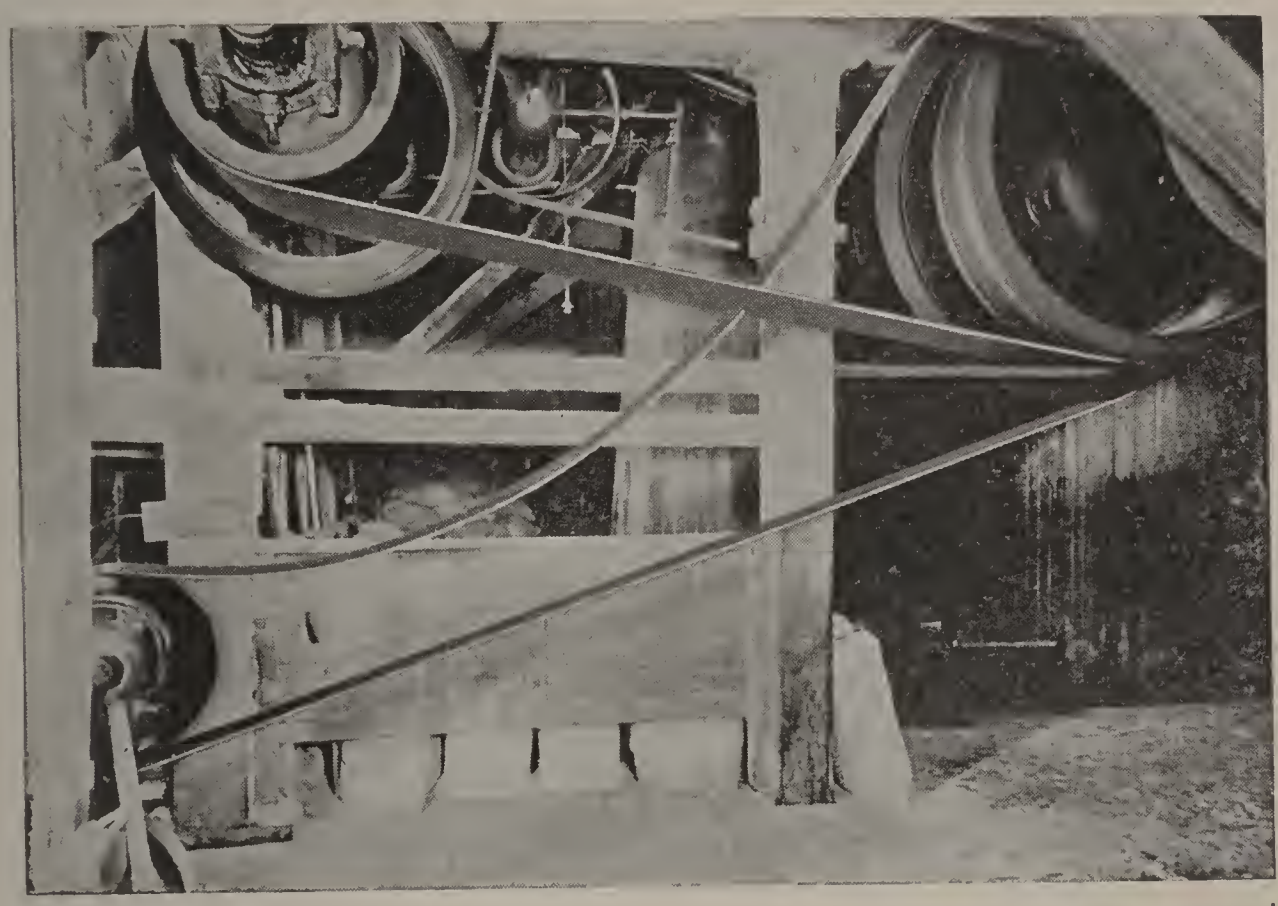
Dust particles that float about a plant and settle upon the belts and pulleys and cling to them are often a prolific source of bad belt contact and slip and when these particles are further attracted by the use of some sticky preparation that stays on the outside of the belt, the lumps formed interfere with rather than help transmission. This is especially true in wood-working shops on account of fine flying sawdust and in clay or flour mills where the dust is almost like smoke.

Belts properly treated with Cling-Surface do not collect dust because the Cling-Surface goes *into* the belts. Too much Cling-Surface at a time, may, however, collect dust, and any collection, rolling up, or lumping, indicates that the Cling-Surface has been applied too cold or that the treatments have been too heavy or too often or both or have been put on dirty belts. Even if used hot, either the quantity used or frequency of application or both should be decreased.

Treatment in dusty places should be almost entirely through the back. The face should be given as little as possible, only enough to prevent slip, while the Cling-Surface is working through from the back. Another way, where possible, with leather belts, is to treat the back only for two or three weeks. Then the belt should be turned right over, and the new back treated for a similar time. Then reverse to original position. This gives both sides a good start in spite of the dust. An occasional light scraping will help

such belts, or treatment can be started for the pulleys as for new belts. (See page 34).

Painted cotton, rawhide, balata and rubber belts must be treated *very* lightly in dusty places, as shown in scale for rubber (see guide, inside front cover) and only once in two or three days or longer (always wiping off dust first on these as well as on leather belts). This will take more time, but if persisted in, will succeed.



A Cling-Surface-treated belt doing 80 horse power on uneven load. Reliance Flour Mill, Providence, R. I. The belts in this mill were gradually changed over to the loose drive idea, delivered more power, and with reduced strain on shafting and bearings after Cling-Surface treatment. The fine dust abounding in this mill made no trouble, as the Cling-Surface penetrates INTO the belts.

Belts subjected to both heat and dust

Belts in factories where rubber goods are made, run at a great disadvantage, as the rooms are, as a rule, abnormally heated and the air is hot and dry. Added to this, the atmosphere is often charged with dust, consisting mainly of talc, which has remarkable anti-friction qualities. Under these conditions something to keep the surface of the belts in working condition is necessary.

Perhaps the best evidence of the value of Cling-Surface treatment for such plants is its use by a leading manufacturer of rubber belting, whose entire equipment is served by belts of his own manufacture. After having applied Cling-Surface treatment under critical observation for nine years, this firm tells us that Cling-Surface fills the requirements in a very satisfactory manner. (See bottom of page 76.)

The action of Cling-Surface on burned belts

Leather belts which have never been treated with Cling-Surface frequently slip so much that the surface friction between belt and pulley face burns hard and unyielding patches on the face of the belt. In hot climates or rooms very little additional heat from slipping is necessary to do this damage. These charred patches may be unnoticed because the heavy pressure and pulley action have rolled them smooth.

Cling-Surface applied to such leather belts sooner or later loosens the dead or charred pieces of leather. These come away from the healthy leather around and behind them like the old skin from a blister. Blame should not be attached to Cling-Surface for this because the Cling-Surface is only making plain or removing some lifeless material which has done the belt no good but has blocked the way for better service. Cases where the burning has

DriveR pulley, 13-inch diameter, 900 revolutions per minute. DriveN pulley, 78-inch. Belt speed, 3060 feet per minute.

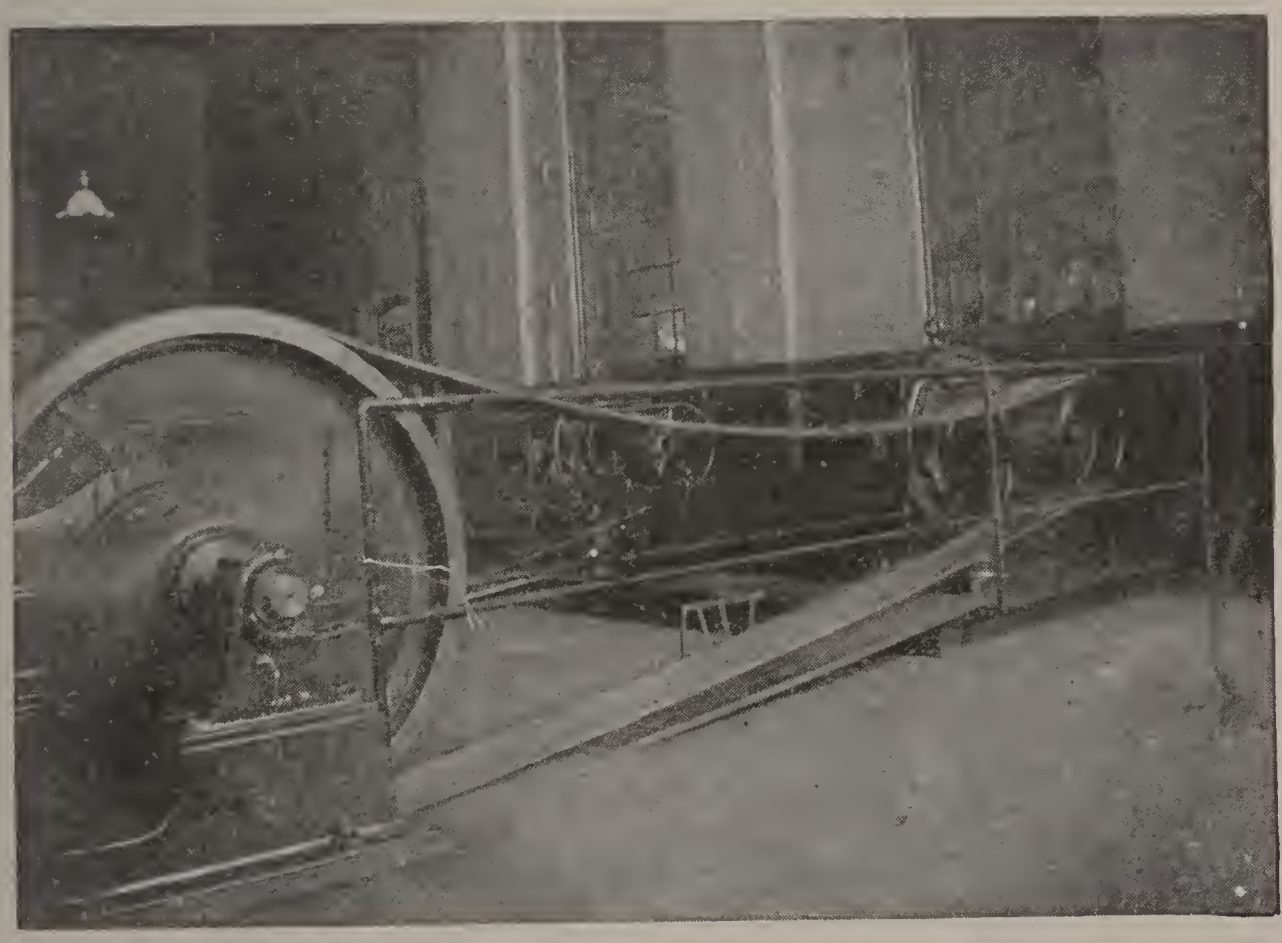
A 16-inch double leather motor belt transmitting 100 horse power to an air compressor at the quarries of the Woodbury Granite Co., Bethel, Vt. Before Cling-Surface treatment was applied here, the belt was run tight, yet slipped so much that the room was filled with the odor of burning leather. The first Cling-Surface treatment stopped the slipping, and although now running with an 18-inch sag, this belt has never slipped since. Cling-Surface treatment was started here in November, 1912, and the above photo was sent us early in the following January.

been thus severe are more common than is usually supposed. (See illustration, page 50.) When they are found, continuation of the Cling-Surface treatment makes the part of the belt under the charred surface as good as ever and checks further disintegration.

Static electricity checked by Cling-Surface treatment

Static electricity developed by belts is often a troublesome factor. One of its common pranks is the destruction of the filaments of incandescent lamps hung near the offending belt. Perhaps the most common cause of static electricity is the slipping of belts on their pulleys; it may also be caused by passage of belts near iron railings, through floors, or by other belts. High speed belts are more subject to static than are slow speed and may even generate it within themselves, possibly from the friction between internal fibers. Dry air or surroundings seem to be an essential to these conditions, for when the air or surrounding objects are damp, static is not noticeable.

Cling-Surface treatment stops trouble from static entirely in most, and lessens it in all, cases by preventing belt slip and internal friction. The belt



Drive R pulley, 56-inch, and drive N, 16-inch diameter. Distance between shaft centers, 12 feet, 6 inches. Belt speed, 4250 feet per minute.

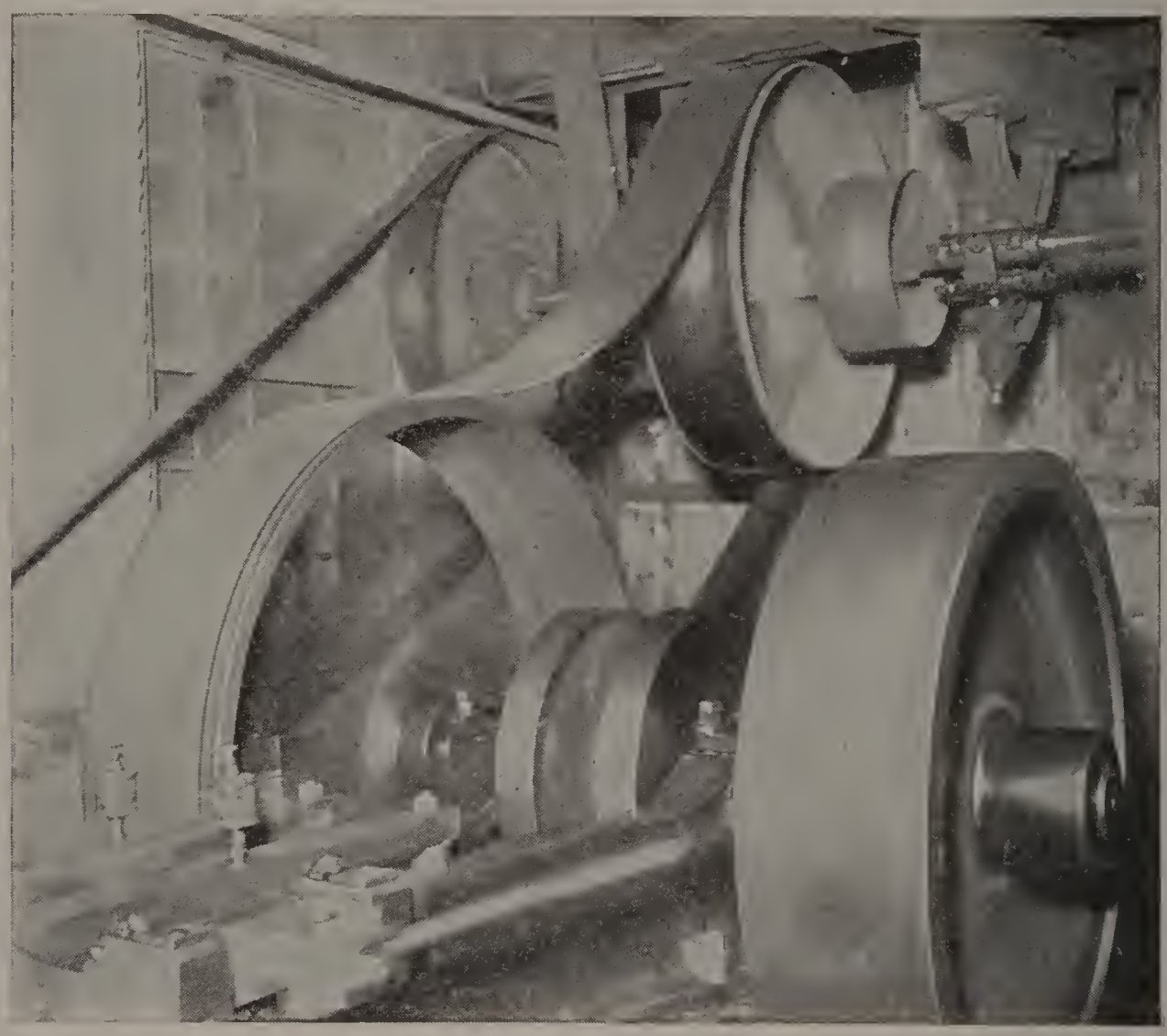
An 11-inch double leather generator belt (supplying 75 arc lights in a railroad shop) which, when run tight, was so constantly filled with static electricity that the small chains shown in the picture were tried as a remedy. This belt was cleaned, filled with Cling-Surface, eased up, and was thereafter run slack as shown and without slip. There was no static electricity developed and the chains were pushed aside as shown.

should be treated back and face for best results. (See illustration page 51.)

Belts with short center distance

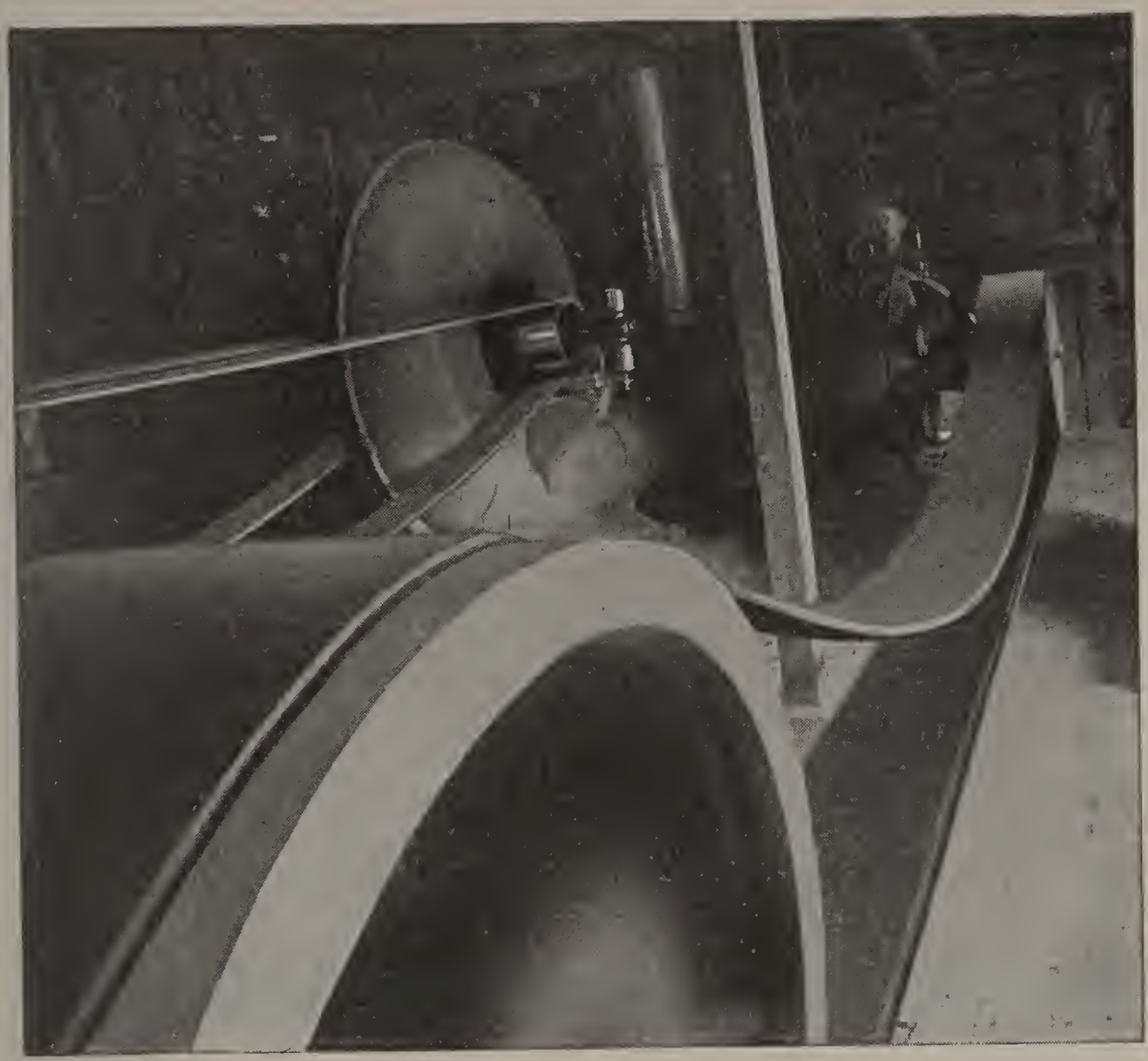
Short distance between centers of driving and driven shafts imposes very severe duty upon belt, pulleys, shafts and bearings if the belt is heavily loaded. The belt under usual conditions must be drawn quite tight to prevent slip and the horse power obtainable depends more upon high belt speed than upon the strength of the belt for work under ordinary conditions. This is especially true when one of the pulleys differs greatly in size from the other, because of the reduced contact area on the smaller pulley.

While these conditions are sometimes unavoidable and to be deplored, Cling-Surface treatment will invariably improve the belt service here and any number of instances can be cited where a short belt, once tight, is now



DriveR pulley, 4-foot 6-inch diameter, 180 revolutions per minute. DriveN pulley 4-ft. diameter. Distance between shaft centers, 8 ft. Belt speed, 2540 ft. per min.

10-inch double leather belt transmitting 35 horse power in the plant of Peninsular Tool Mfg. Co., Detroit, Mich. With Cling-Surface treatment this belt ran with 15-inch sag, never had to be taken up, did its work well regardless of under or overloads, and is good proof that a non-slipping belt can be run easy on short centers as well as on long. The pulley faces are only 45 inches apart at the nearest, yet 15 inches of slack is practical in so small a space.



DriveR pulley, 30-inch diameter, 675 revolutions per minute. DriveN pulley, 28-inch diameter. Distance between shaft centers, 14 feet. Belt speed, 5300 feet per minute.

Several hundred belts have been regularly treated with Cling-Surface for ten years in the railroad shop in which the above picture was taken. NO BELT IN THIS ENTIRE SHOP IS RUN TIGHT. The 12-inch 2-ply leather belt in the foreground transmits 70 horse power and after two years of Cling-Surface treatment runs with 24½-inch sag, but no slip.

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being run very slack after Cling-Surface treatment, the slack giving a big increase of contact area on the small pulley, right where it is most needed. (See illustrations, pages 22 and 44.)

Long center distance

Mr. F. W. Taylor mentions twenty to twenty-five feet as the distance between shaft centers from which best belt service is obtainable. On belts for this length and over, the belt should be uniform throughout to prevent irregular running, and for this reason textile belts or leather belts made only from the center of the hides are recommended for extremely long drives. The weight of the length of belt between pulleys becomes a material addition to the load and for this reason small pulleys requiring sharp bending of the belt should not be used under these conditions.

The benefits from Cling-Surface treatment are at a maximum on long belts. The waterproofing effect prevents change in length under varying humidity and the penetration of the Cling-Surface gives the belt surface high tractive power and the interior a flexibility that takes the bends with the least possible internal friction.

The effect of Cling-Surface on shifting belts

Usually the treatment of shifting belts with Cling-Surface gives perfect results and does not interfere with shifting of belts of any width back and forth on tight and loose pulleys. There seem, however, to be conditions as, for instance, where heavy loads are carried on thin belts, that treatment is not to be recommended because the cure of slip is so complete that the belt resists the shift. Undoubtedly forks placed on the slack side lead the belt over with least strain on the belt, but sticks or rods on any part should not be continually depended upon to keep a belt in place. Rubber or canvas belts

Where Cling-Surface treatment defeated the effect of moisture and the quarter turn. Steam and surrounding moisture are natural belt enemies in this plant, a laundry, and these, with the bad turns, had used up three belts on the above 30-horse-power drive within a year. The belt shown running between 28-inch pulleys at 180 revolutions per minute was first treated with Cling-Surface as an experiment. At the time photographed it had seen THREE YEARS' service, was transmitting full load with 4-inch slack on one loop and 6-inch on the other and still in perfect condition. It runs without slip and in fact so slack that it would drop off the angle pulley but for the help of the hanger.

A 10-inch double leather crossed belt running on 30-inch pulleys, Maddock Pottery Co., Trenton, N. J. Note the extreme slack which prevents scraping at the cross. This belt is located directly over a flint bin where the dust and grit are so bad that the pulley faces, originally crowned, had worn concave and had to be renewed before the belt was put on. Regular and proper use of hot Cling-Surface in small amounts at a time enables this and about 25 other belts in the same room to do their work and remain in splendid condition.

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when shifted are apt to fray and open up at the edge, letting the belt stretch irregularly.

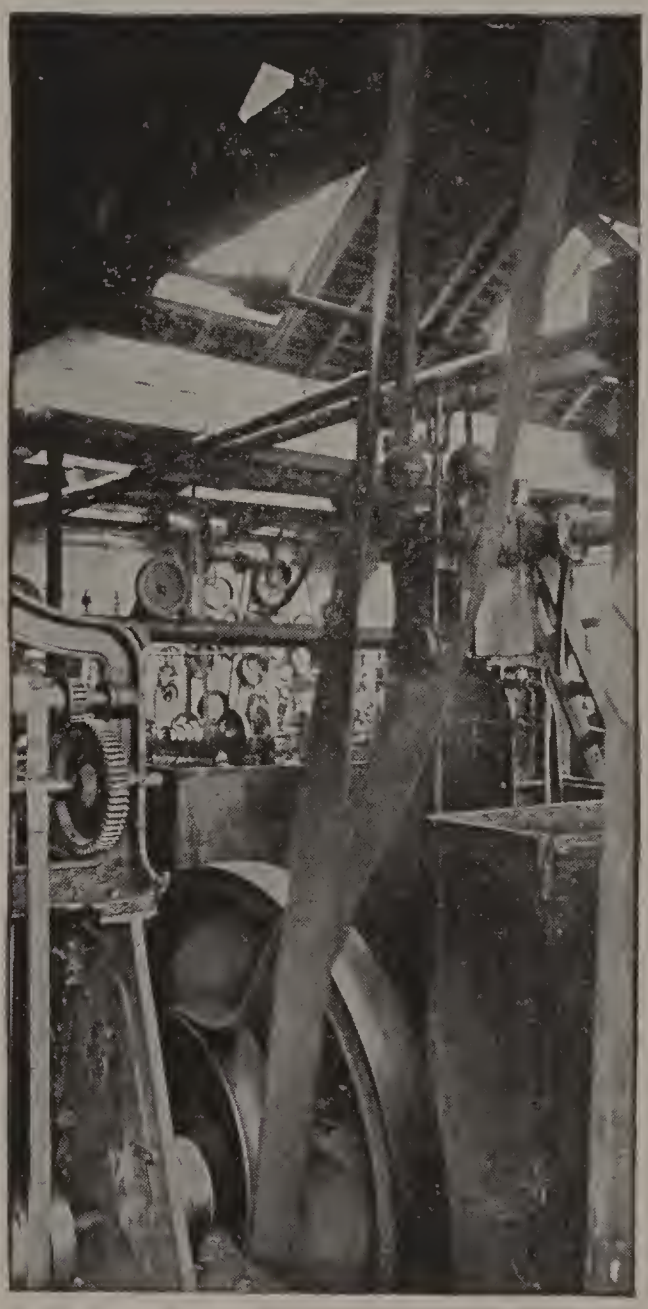
Perhaps the best form of belt-shifter is a pair of rollers of twice the width of the belt. either of which may be pressed on the slack side of the belt, on its flat surface close to the driving pulley. The axis of the roller makes an angle of 75 degrees with the center line of the belt.

Quarter-turn and cross belts benefited by Cling-Surface

Where pulleys are at right angles to each other and the quarter-turn belt sometimes will not come down on the pulley face and only one half of width of belt touches on top of the pulley, Cling-Surface will remedy the trouble if the belt is sufficiently treated. The belt will become pliable, lie flat on pulley, do far better work and last much longer, as the strain is taken off the edge of the belt.

Crossed belts are equally benefited by Cling-Surface treatment and similarly can be made to run easy and do perfect work.

DriveR pulley, 4-foot 6-inch, and driveN, 3-foot 6-inch diameter. Distance between centers, 22 feet.



A 6-inch double leather crossed belt transmitting 40 horse power in the plant of Gold & Co., Birmingham, England. Although this is a small belt for such a big load it runs very loose under Cling-Surface treatment, does not rub at the cross, and never causes hot bearings as it did formerly when run tight.

DriveR pulley, 2-foot 11-inch diameter, 60 revolutions per minute. DriveN pulley, 2-foot 3-inch diameter. Distance between shaft centers, 12 feet 1 inch. Belt speed, 550 feet per minute.

A 6½-inch crossed leather belt treated with Cling-Surface. Earl of Shrewsbury's Brereton Colliery, Rugeley, Staffs, England. Note the 16-inch slack and the increased pulley contact obtainable to produce the complete stoppage of slip, only possible through the use of Cling-Surface.

Various tests of Cling-Surface

Many tests of Cling-Surface and the treatment for which it forms the basis have been made in shops, mills and laboratories.

We quote here a few on leather belting to emphasize the far-reaching results of Cling-Surface treatment and that Cling-Surface is not injurious to any belt fabric. Tests on canvas belting will be found on pages 69 and 74.

We would call special attention to the contrast with castor oil, which is used for belt treatment in some plants because castor oil makes the belts look clean and smooth. Castor oil is one of the gummiest oils known and is subject to decomposition into elements which are positively harmful. The gum forms as the oil dries out (oxidizes). It dries slower in the belt than outside, but none the less surely and as the gum dries it cracks and the belt fibers crack with it. This is what makes the fine transverse cracks on the backs of castor-oil-treated belts.

Test of Cling-Surface for chemical purity

A chemical test was made of Cling-Surface and neatsfoot oil, at the Department of Chemistry of Cornell University, testing for free fatty acid, alkali, ammonia, mineral acid and rosin. The report showed these results:

Cling-Surface:	Fatty acids	$\frac{27}{100}$ of 1 per cent
	Rosin	None
	Free alkali	"
	" ammonia	"
	" mineral acid	"
Neatsfoot oil:	Fatty acids	$\frac{70}{100}$ of 1 per cent

This neatsfoot oil was the best procurable in the local market and the Cling-Surface was a year old when tested.

Cling-Surface is free from all harmful materials and nearer neutral than any oil or grease, either natural or manufactured, usable for belts.

Prof. E. C. Karch, director of the Kgl. ver. Maschinenbauschulen, Cologne, Germany, confirms the above statements as to the purity of Cling-Surface in a letter to our German office as follows:

> "I have had much experience with Cling-Surface for a considerable period and at various places. I am very satisfied with the results. Cling-Surface cannot be placed among inferior belting greases and adhesive preparations, but is a product to be taken seriously, which in no wise injures the belts and which can therefore be heartily recommended.
>
> "To prove the harmless nature of Cling-Surface I had same examined by the Royal Material-Testing Office at Grosslichterfelde West; the result of this examination is stated in the Certificate of Examination A. N. 51884, Sect. 6 N. 5850 and reads as follows: '*Free mineral acids, free alkali and resin, which according to general experience are injurious to leather and ropes, are not present,*' and further, '*Mineral substances, tar, resin oil, and free organic acids are not present in any quantities which can be detected.*'"

Dr. R. Gartenmeister, of Elberfeld, Germany, a chemist who has done German Government work and who because of his high professional reputation was asked to report on Cling-Surface, states:

"Cling-Surface is made of neutral greases, is of a dense but not sticky nature and contains no mineral or other products which would damage leather, camel's hair or cotton belts or hemp or cotton ropes."

Mr. Ernest J. Parry, B. Sc., T. I. C., F. C. S., of London, who is recognized as one of the leading analytical and consulting chemists of the oil and grease trade in Great Britain, reports on Cling-Surface as follows:

"The sample was selected from several hundred large cases lying in the warehouses by my assistant, and is therefore representative.

"I made a full analysis of same, and found it to be free from any matter which would have corrosive effect on leather, canvas, cotton or similar fibers. It would not have corrosive effect if accumulation took place on the fibers, but would rather tend to protect them. It is in my opinion perfectly suitable for lubricating belts of leather or fibers of any kind."

Dr. J. Gordon Parker of London, perhaps the greatest leather expert in the world, and the man who was selected by the University of Cambridge to choose the leather binding for the latest (10th) edition of the Encyclopedia Britannica, made the following report upon his analysis of Cling-Surface:

"I have made a careful examination of Cling-Surface. The sample was drawn by my assistant from a large number of tins contained in your London warehouse. I find that the material contains no mineral acids, nor was I able to find any ingredients likely to be detrimental to the fibers of leather, canvas, cotton or other belting. I also tried a portion of the sample on belting in my laboratory and found it very beneficial."

Comparative tests of new leather belts with and without Cling-Surface treatment

Tests in 1912 by Mr. Robert Thurston Kent, Mem., Am. Soc. M. E. assisted by Wm. F. Schaphorst, Jun., Am. Soc. M. E., formerly a Professor of Mechanical Engineering in the New Mexico State College, to determine the relative pulling power of treated and untreated belts, at different arcs of contact on the pulley, and at varying tensions on the belt, were made as follows:

The belts tested were single-ply new leather belts, 4 inches wide and of an average thickness of 0.193 and 0.230 inch. Both belts were run under identical conditions, without load, over 12-inch pulleys for a period of eight weeks, one being treated with Cling-Surface according to the directions for its use. The Cling-Surface was applied by Mr. C. F. Chase of the Cling-Surface Company.

Static tests were used, instead of tests with the belt in motion over pulleys, to investigate the effect of varying the tension on the slack side and for the reason that it was desired to fix definitely the tension that would correspond to the tension on the slack side of a running belt.

The apparatus used was a modification of that used by Briggs and Towne to determine the coefficient of friction of leather belts. The arrangement is shown in Fig. 1, page 59. The method of operation was as follows:

A known weight was suspended from the belt at the point A. The arc of contact of the belt on the pulley was varied by means of the framework B,

which could be revolved around the pulley shaft C. The end of the belt D was attached to a pair of spring balances connected to a cross-bar, in which was fastened a nut. A long screw passed through the end of the frame-work B, and entered in the nut. The weight being applied at A, a sufficient length of time was allowed for the belt to come to rest on the pulley, after which a tension was put on the opposite end of the belt by tightening the nut on the screw.

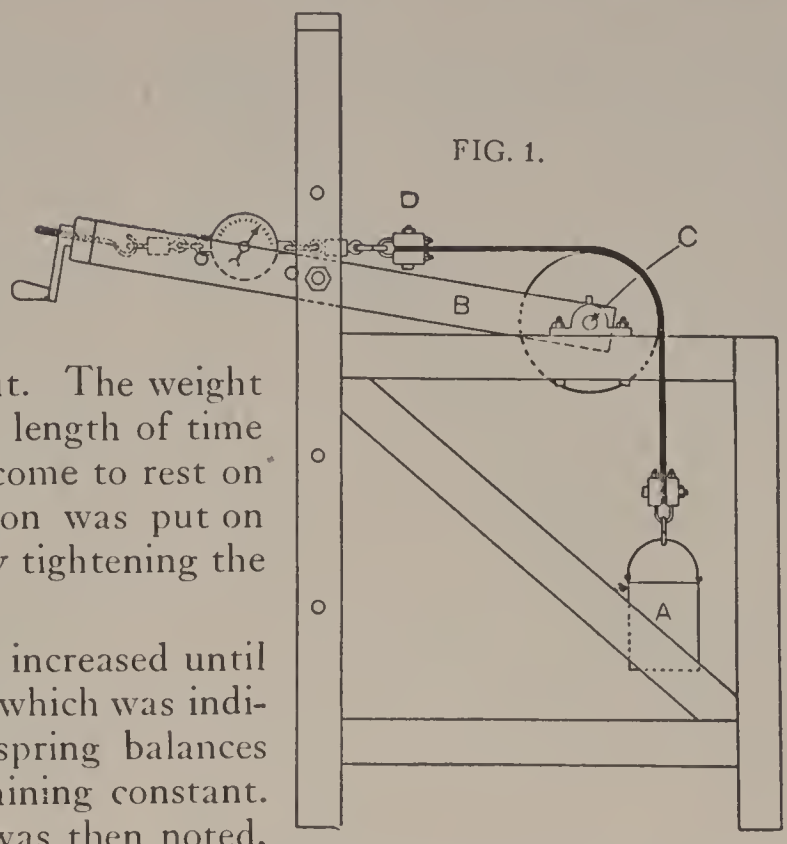


FIG. 1.

The tension was gradually increased until the belt slipped on the pulley, which was indicated by the reading of the spring balances ceasing to increase and remaining constant. The spring balance reading was then noted, and the tension released. An increased load was applied at A and the operation repeated, until the capacity of the spring balances was reached. The untreated belt was then removed from the apparatus and replaced by the treated belt, which was then tested under the same conditions. After both belts had been tested at a given arc of contact up to the limit of the apparatus, the arc was changed and the operation was repeated. Tests were made at the following arcs of contact: 125 degrees; 135 degrees; 153 degrees; 180 degrees. The pulley was cleaned with gasoline before each test. The spring balances were calibrated before and after each series of tests.

The first four sets of curves, page 60, are plotted from the test readings and give the relation between the tensions on tight and slack sides of both treated and untreated belts for various angles of contact.

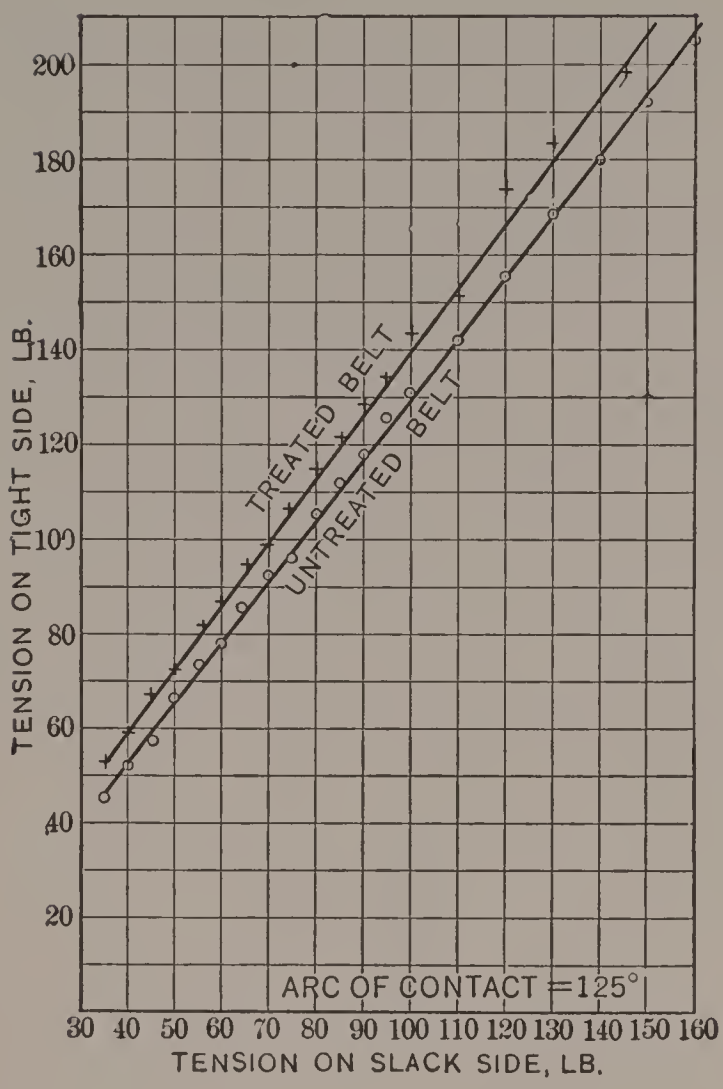
Reference to these curves shows:

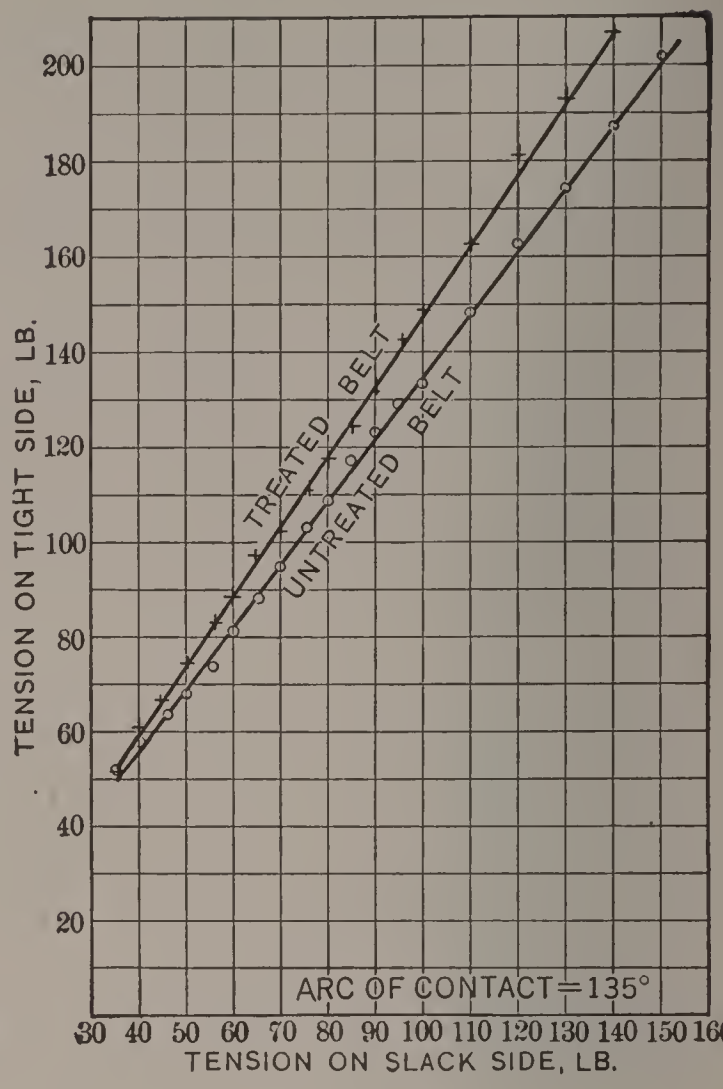
First, that with arcs of contact less than 180 degrees, the tension on the tight side increases more rapidly with the treated than with the untreated belt as the tension on the slack side is increased.

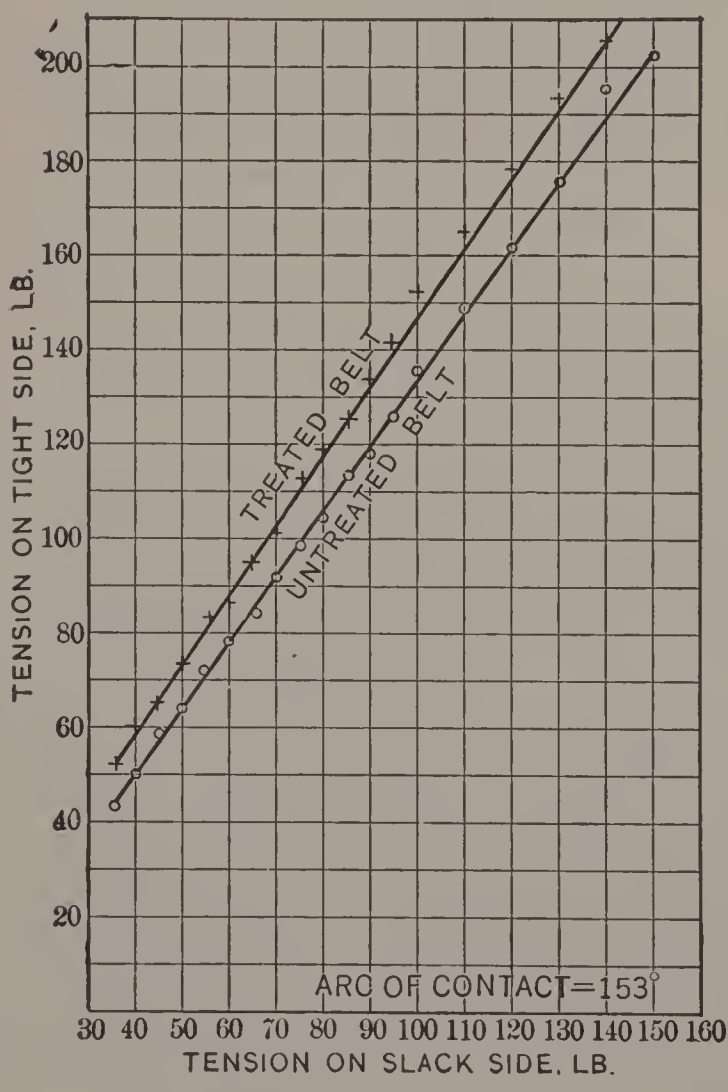
Second, that with arc of contact of 180 degrees, the tension on the tight side increases at practically the same rate with the treated as with the untreated belt as the tension on the slack side is increased.

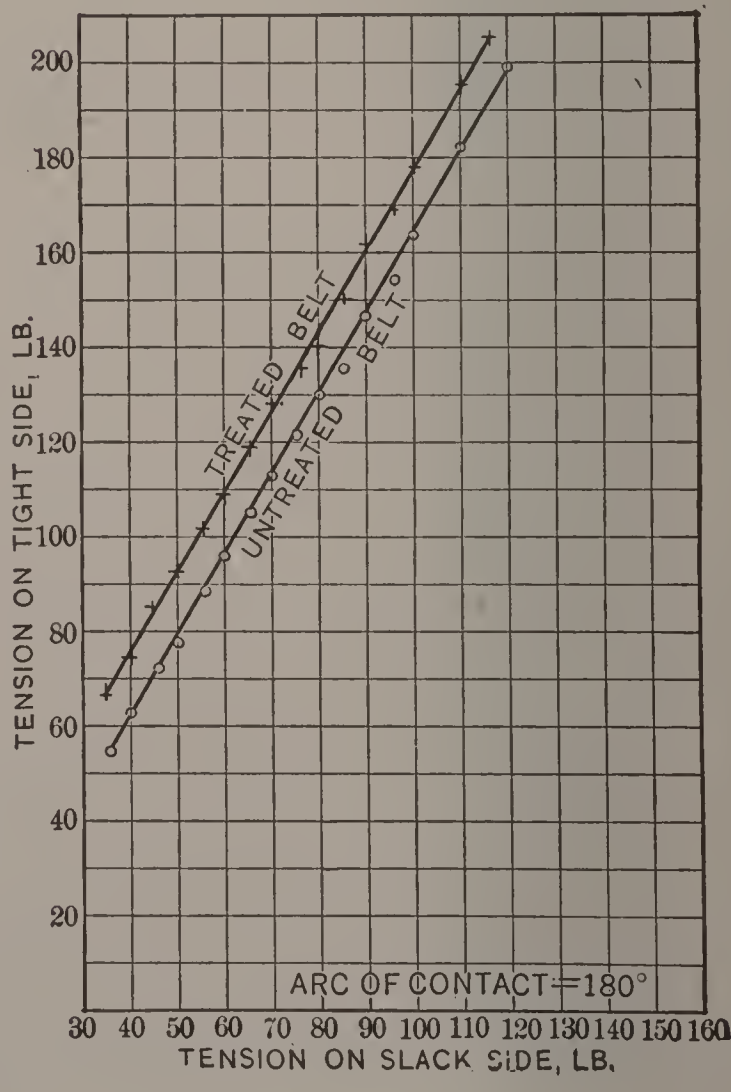
Third, that at all arcs of contact and under all conditions regardless of the tension on the slack side, the pulling power of the Cling-Surface-treated belt is greater than that of the untreated belt.

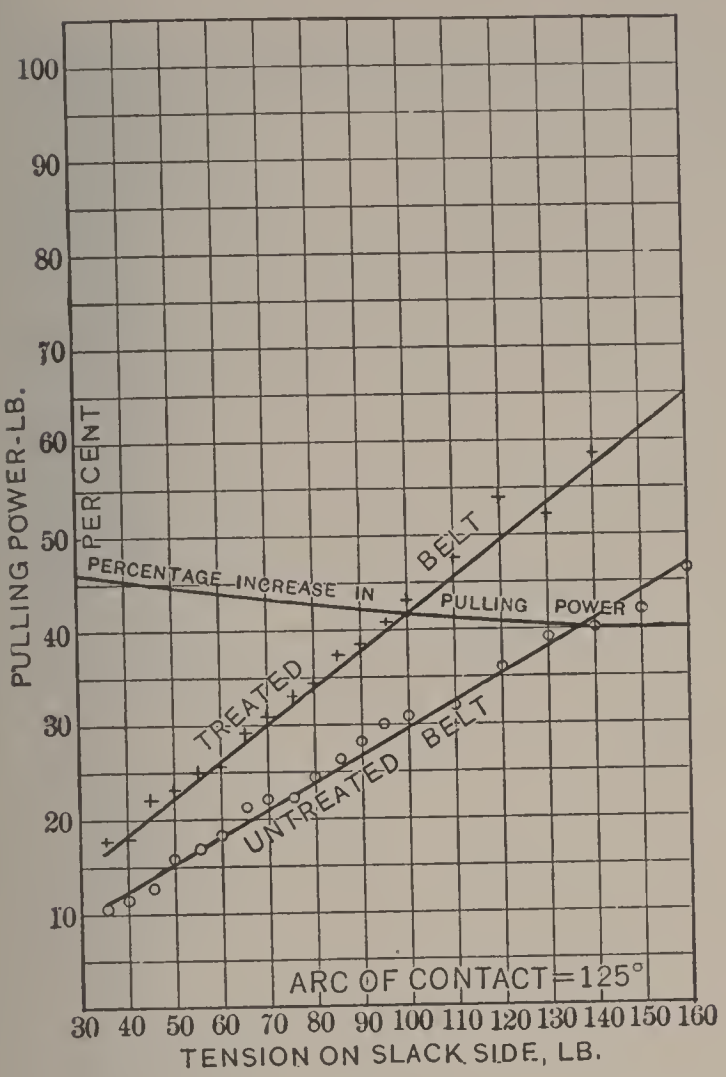
Bearing in mind that the effective pulling power of a belt is the difference in tension on the tight side (in this case, the tension shown by the spring balance readings) minus the tension on the slack side (the weight suspended from the belt), the second set of curves, page 61, was plotted to show this effective pull for both the treated and untreated belts for all tensions on the slack side. An additional curve on each of this set shows the percentage increase of pulling power of the treated belt over that of the untreated belt at various values of the tension on the slack side.

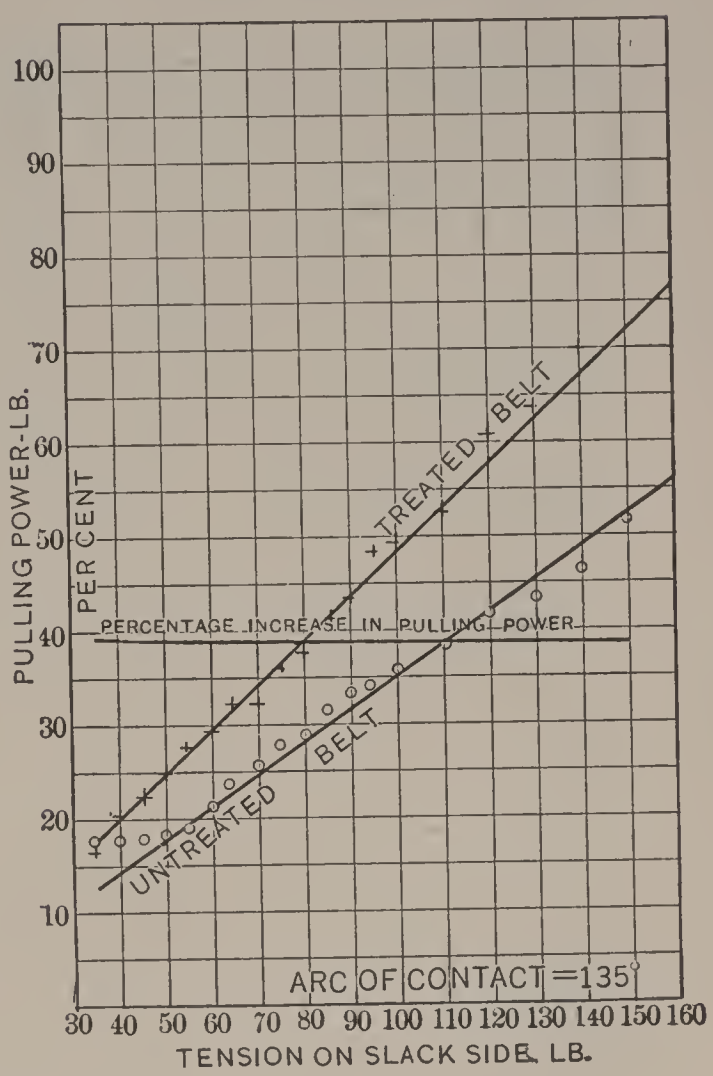

TENSION ON TIGHT SIDE, LB.
200
180
160
140
120
100
80
60
40
20
TREATED BELT
UNTREATED BELT
ARC OF CONTACT = 125°
30 40 50 60 70 80 90 100 110 120 130 140 150 160
TENSION ON SLACK SIDE, LB.

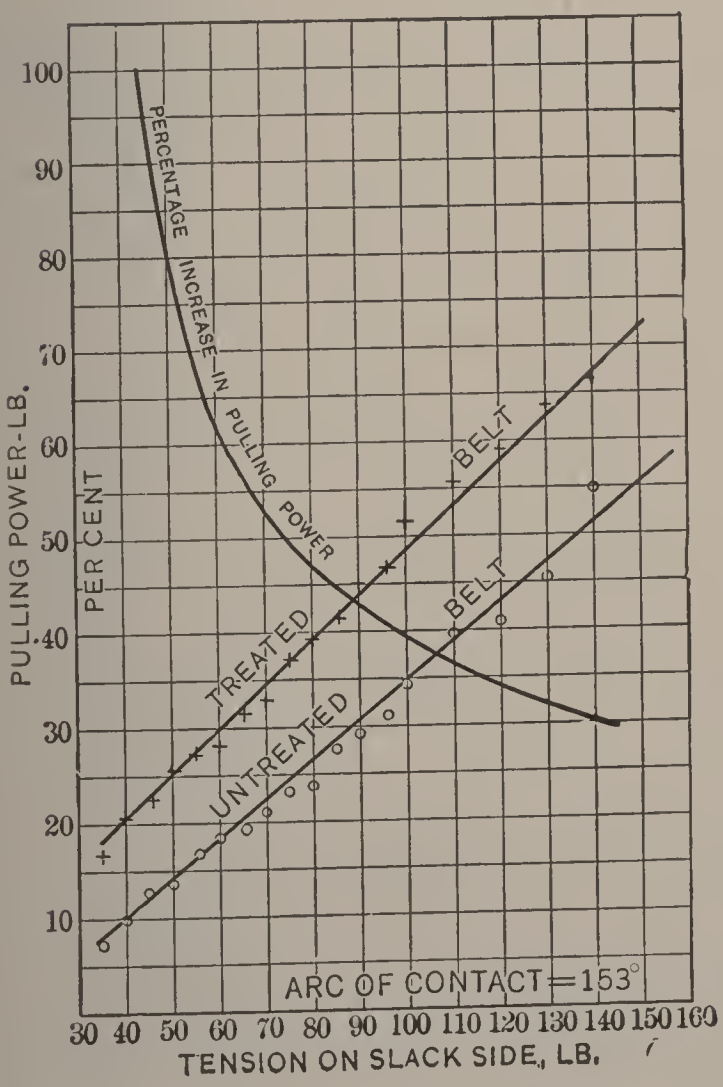

TENSION ON TIGHT SIDE, LB.
200
180
160
140
120
100
80
60
40
20
TREATED BELT
UNTREATED BELT
ARC OF CONTACT = 135°
30 40 50 60 70 80 90 100 110 120 130 140 150 160
TENSION ON SLACK SIDE, LB.

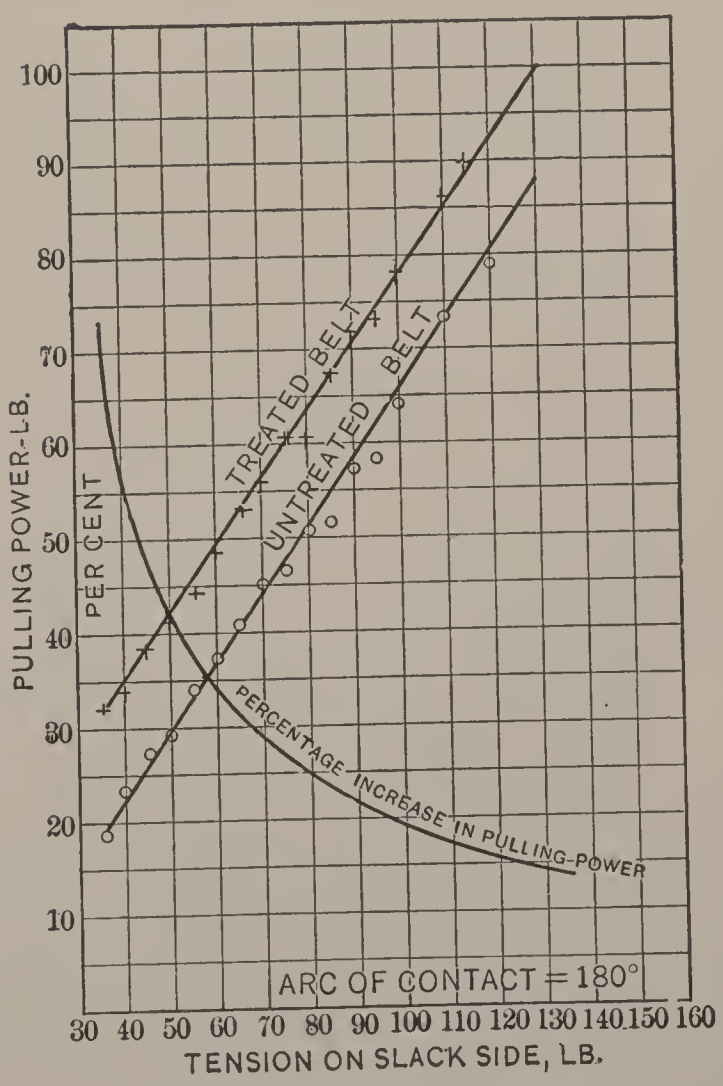

TENSION ON TIGHT SIDE, LB.
200
180
160
140
120
100
80
60
40
20
TREATED BELT
UNTREATED BELT
ARC OF CONTACT = 153°
30 40 50 60 70 80 90 100 110 120 130 140 150 160
TENSION ON SLACK SIDE, LB.


TENSION ON TIGHT SIDE, LB.
200
180
160
140
120
100
80
60
40
20
TREATED BELT
UNTREATED BELT
ARC OF CONTACT = 180°
30 40 50 60 70 80 90 100 110 120 130 140 150 160
TENSION ON SLACK SIDE, LB.


PULLING POWER-LB.
PER CENT
PERCENTAGE INCREASE IN PULLING POWER
TREATED BELT
UNTREATED BELT
ARC OF CONTACT = 125°
TENSION ON SLACK SIDE, LB.


PULLING POWER-LB.
PER CENT
PERCENTAGE INCREASE IN PULLING POWER
TREATED BELT
UNTREATED BELT
ARC OF CONTACT = 135°
TENSION ON SLACK SIDE, LB.


PULLING POWER-LB.
PER CENT
PERCENTAGE INCREASE IN PULLING POWER
TREATED BELT
UNTREATED BELT
ARC OF CONTACT = 153°
TENSION ON SLACK SIDE, LB.


PULLING POWER-LB.
PER CENT
TREATED BELT
UNTREATED BELT
PERCENTAGE INCREASE IN PULLING-POWER
ARC OF CONTACT = 180°
TENSION ON SLACK SIDE, LB.

Reference to pulling power curves shows:

First, that at arcs of contact of less than 180 degrees, the actual pulling power of the treated belt increases more rapidly than that of the untreated as the tension on the slack side increases; and at an arc of contact of 180 degrees the pulling power of the treated is greater than that of the untreated belt by about the same definite quantity for all tensions on the slack side.

Second, that with tensions below 100 pounds on the slack side, the actual increase in pulling power of the treated over the untreated belt is greater with a 180-degree arc of contact than with smaller arcs of contact, and decreases with decrease of the arc of contact.

Reference to the curves showing percentage of increase of pulling power of the treated over the untreated belt shows the following:

First, that at lower tensions on the slack side, the increase of pulling power becomes much higher in proportion as the arc of contact increases.

Second, that as the tension increases on the slack side of the belt, the percentage of increase of pulling power of the treated belt over that of the untreated becomes greater as the arc of contact becomes less.

Third, that minimum tension on the slack side and maximum arc of contact are the most desirable operating conditions.

Fourth, that decreasing the tension on the slack side of the belt to a low figure, and increasing the arc of contact increases the pulling power of a treated over that of an untreated belt in an increasing ratio.

The limit of the decrease in the value of the tension on the slack side of any belt is the point at which the belt will slip on the pulley. The belt will be exerting its maximum pulling power at the instant just before it slips. The value of treating a belt with Cling-Surface lies in the fact that the tension on the slack side of the belt so treated, may, owing to the greater coefficient of friction, be decreased to a much lower value than that of the belt not so treated, before slip occurs. This decrease in the initial tension is accompanied by an increase in the length of the belt, thereby giving it a greater wrap, or arc of contact on the pulley. These two factors both tend to increase the pulling power of the treated belt over that of the untreated belt in an increasing ratio. The following example will make this point clear:

Assume that, with an arc of contact on the pulley of 180 degrees, an untreated belt would slip when the length of the belt was such that the tension on the slack side was just under 35 pounds. From the 180-degree curve, page 61, the pulling power of an untreated belt is 19 pounds and of a treated one 31.5 pounds. The increased pulling power of the treated belt over the untreated one under these conditions is 66 per cent. Now assume that the belts be lengthened so that the arc of contact is 270 degrees. This will decrease the tension in the belt to such an extent that the untreated belt will slip, while the coefficient of friction of the treated belt is sufficiently greater than that of the untreated belt to prevent the treated belt from slipping under the same conditions. The friction—and therefore the pulling power—increases directly with the arc of contact. Hence an increase in the arc of contact to 270 degrees would increase the pulling power of the treated belt to 47.2 pounds. As the untreated belt will slip with any further decrease in the tension on the slack side it will be impossible to use a greater arc of contact for it than 180 degrees. The increase of pulling power of the treated belt at 270 degrees arc of contact over the pulling power of the untreated

belt at 180 degrees (the maximum possible) is 49 per cent. As the curves show that the decrease in the value of the tension on the slack side of the belt increases the pulling power at 180 degrees arc of contact, in an increasingly rapid proportion, and as this tension is decreased by lengthening the belt to obtain the additional arc of contact, the actual increase in pulling power will be greater than the 49 per cent given above.

While it is not within the province of the experiments here described, an explanation of the cause of the action of Cling-Surface in increasing the friction of belts on the pulleys, particularly at low values of the tension on the slack side and at high arcs of contact, may be attempted.

On page 1195 of the 8th edition of Kent's "Mechanical Engineer's Pocket-Book" are the following statements regarding unlubricated friction:

> "The friction of fibrous material is increased by increased extent of surface and by time of contact and is diminished by pressure and speed." * * * * * "Friction is greatest with soft, and least with hard materials."

As indicated above, the greatest coefficient of friction enables belts treated with Cling-Surface to be run at a lower tension on the slack side, with a consequent greater arc of contact than belts not so treated. This results necessarily in a greater time of contact while a given length of belt is passing over the pulley, and by an increased extent of surface in contact with the pulley. According to the above statement this will increase the total friction, and therefore the total pulling power of the belt. Likewise the decrease in pressure due to the greater length of belt contacts necessary to obtain the low tension on the slack side increases the friction of the belt on the pulley, and therefore its pulling power.

The belts used in the experiment which were treated with Cling-Surface were noticeably softer and more pliable than the untreated ones, which in accordance with the second statement quoted above, would tend to increase the total friction of the belt on the pulley.

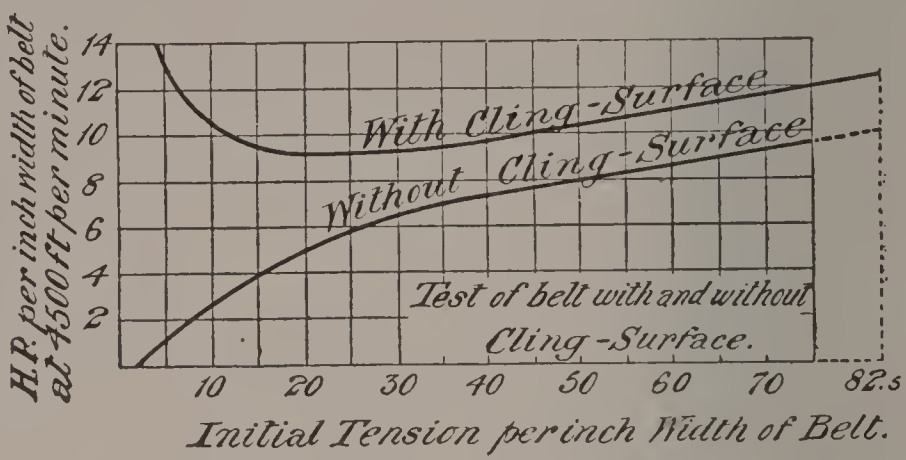
Tests of Cling-Surface treatment by Prof. R. C. Carpenter, at Sibley College, Cornell University

The belt testing apparatus at Cornell is probably the most complete in existence. This machine records power supplied, power delivered, belt tension, contact and slip.

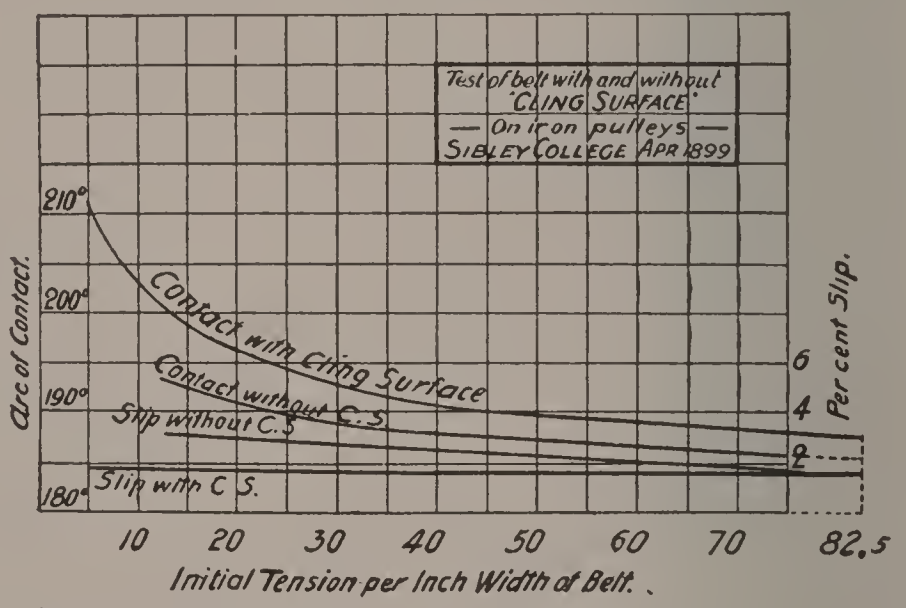
Over fifty tests on belts before and after Cling-Surface treatment were made on this machine under the direction of Prof. Carpenter and at a time (1899) when the theory of slack belts was still frowned upon. The belts were typical and, previous to the tests, had been running under rather better than average conditions. A summation of typical results is illustrated in the two sets of curves on next page. In the first, with belt speed at 4500 r.p.m. the lower curve is characteristic for an untreated belt—more power demanding more initial tension. Note the difference after applying Cling-Surface as shown by the other curve. Even under extreme initial tension, the belt output was *much* better after using Cling-Surface, while with no initial tension other than due to the weight of the belt, the power output was *40 per cent greater than from the untreated belt under the highest initial tension, and fourteen times as great as from the untreated belt under the same tension conditions.* In

short, the belt was capable of doing far more work at all tensions after applying Cling-Surface.

The second diagram shows that under Cling-Surface treatment and greatest loads the belt was wrapping 212 degrees of the pulley instead of the 180 degrees usual with tight belts, yet at all times the slip was under 2 per cent. This slight slippage was mainly legitimate "belt creep" or in other words, practically no slip was present. In short, as the report says, "Cling-Surface enables the full capacity of the belt to be obtained for transmitting power when the belt is so loose that the sides nearly touch."



Showing the increased pull of leather belting under Cling-Surface treatment.

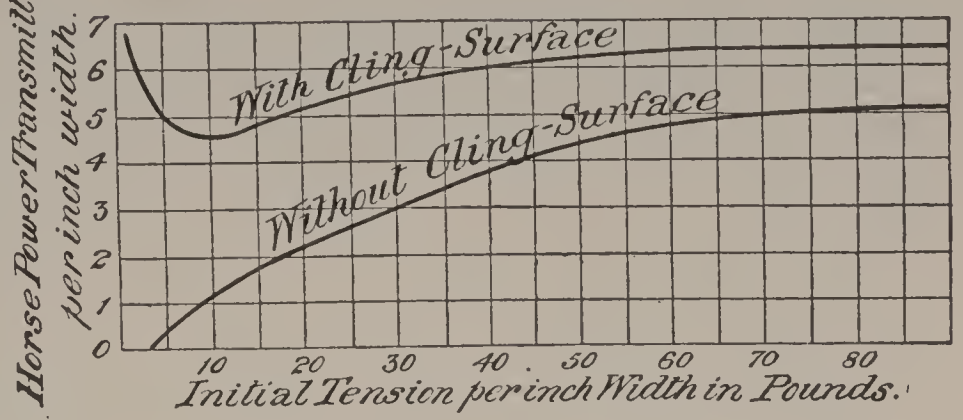


Showing typical increase of pulley wrap and decrease of slip of leather belting under Cling-Surface treatment.

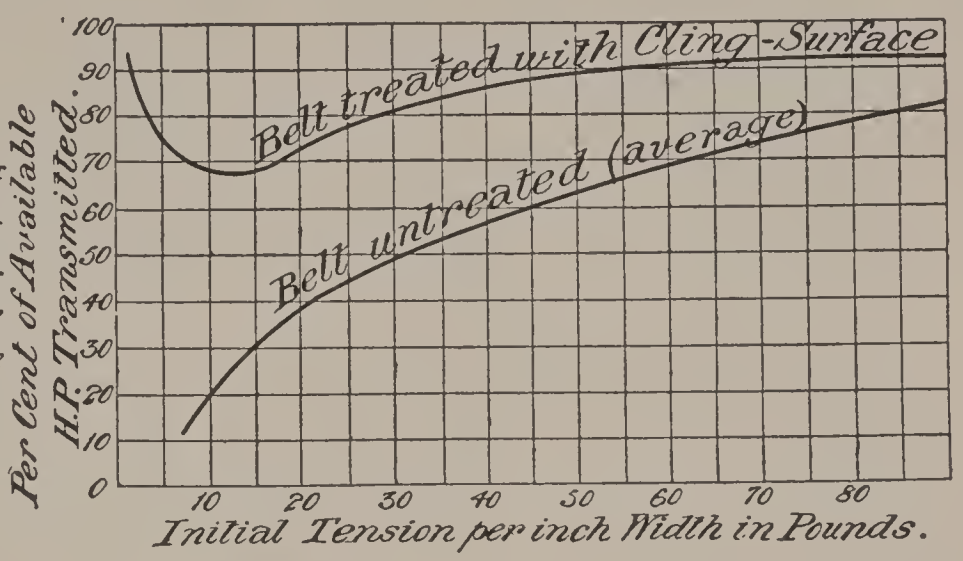
Further tests at Cornell

A second series of tests made by other observers on this same machine in 1905 paralleled the earlier tests in a very interesting way. The belt speed, however, for the second series of tests was 2200 feet per minute instead of the former 4500. Curves from these later tests are given on page 65. The first diagram shows much the same results as the first diagram from the previous tests—always much greater transmission efficiency with Cling-Surface, greatest efficiency under least initial tension and this better than for an untreated belt at its best. The second diagram shows the average efficiency in percentage of power transmitted by four untreated belts compared to efficiency of one of these after subsequent Cling-Surface treatment. It is worthy of note that at 2-pound initial tension (the weight of the belt), the treated belt was 95 per cent efficient as against 15 per cent before using Cling-Surface. Even under 90-pound initial tension, the treated belt transmitted 16 per cent more power than before.

Showing the increased pull of leather belting under Cling-Surface treatment. Belt speed 2200 feet per minute.



Average efficiency of four untreated belts compared to the efficiency of one of these after Cling-Surface treatment.



Test of Cling-Surface treatment in the yarn mill of I. E. Palmer, Middletown, Conn.

This practical test was made on belts of a whole department.

Power statement: 9-13-05: Fitchburg steam engine rated 300 horse power. Steam at 130 pounds from Manning boilers, 350 horse power combined rating. Cards taken September 6 (p.m.) and 9 (after 11 a.m.) weather fair.

Friction only		94.5 horse power
Full load		289.4 "
Divided as follows:	Carding room	116.5 horse power
	Spinning room	135.5 "
	Twisting room	37.4 "
		289.4 horse power

Friction load is 32.6 per cent of total.

Departmental power required exclusive of friction.

Carding room	77 horse power
Spinning room	89 "
Twisting room	29 "
For machinery only	195 horse power
Add friction load	94.5 "
Total	289.5 "
Add casual machines idle at indicating time	10 "
Total	299.5 horse power

As the spinning department takes most power, test was made there. 7884 spindles were run and using 89 horse power; Spindles, per horse power 88.

Belts are as follows: Engine drive, 2000 feet, 1½ inches, four-strand manila rope. Speed 5000 feet per minute. Main drives 225 feet, 12 inch, double leather, speed 400 r.p.m. Spinning Department 600 feet, 2¼ inch, single leather.

This letter gives first report:

Cling-Surface Co.

"Last September (1905) I decided to test Cling-Surface to determine the actual saving. First I took cards of engines to find total and friction load as above. Result: Total 300 horse power, Friction load 32.6 per cent. (Time, Wednesday afternoon and Saturday noon.) I then treated all belts on face with hot Cling-Surface, until pulley showed stain and no more. This was repeated regularly for four weeks as each belt showed need of it. Each Saturday for four weeks all belts were painted on back liberally with hot Cling-Surface. Then all treatment was stopped *for four weeks*, at which time cards were again taken.

"Result: A reduction of 8 per cent in friction load. But during these eight weeks these same machines have turned out an increase of 200 pounds of cotton yarn per week. All belts run slack; weather never affects them; damp Monday mornings have no influence, belts and machines start up much easier than before; bearings are all cool and grade of yarn is better because of even speeds.

"We also notice that belts require much less attention. For instance: 36 short belts, driving spinning frames, and running up through the floor; we were formerly constantly tightening them, now these evershifting belts run quite slack, need no attention and never slip.

"Furthermore the belts have cleaner faces, seeming to reject dust, owing to Cling-Surface not being sticky and absence of static electricity in belts.

"The belts had a little Cling-Surface occasionally until January 25th, 1906, when a third card showed 3 per cent further reduction in friction load, 11 per cent so far, and I believe we will reach 15 per cent at least. The belts now need less and less, as they are becoming filled, and I am convinced that they will last very much longer than before."

March 30, 1906. H. D. Martin, Supt.

Test of Cling-Surface treatment in the silk mill of M. C. Migel & Co., Astoria, N. Y.

(Letter from Mr. H. E. Collins, Consulting Engineer, New York.)

"Last fall I recommended Cling-Surface to M. C. Migel & Co., not so much as a belt preservative but to save power by lessening friction. I gave this work special attention because of the close margins there to keep the plant running at full speed when the heavier loads came on and secured some interesting results.

"First speeds of all main shafts and the friction load of engine were noted.

"After forty-seven (47) days, during which the Cling-Surface was applied to each belt once a week, speeds of shafts and the friction load of engine were again taken and the appended table of data will show you the success we had.

"The results were much better than expected, especially in the friction load, which was decreased over 18 per cent.

"This saving of two (2) horse power, if nothing else, means a saving of at least $100.00 per year to the firm, which would easily pay the expense several times over of the Cling-Surface used.

"With proper attention and a much smaller amount of Cling-Surface each year the same results should be secured, as my work demonstrates can be done.

"Added to this saving in friction, the value of the product is certainly increased as the steadier speed of shafting gives a more uniform tension of the cloth woven and the average output must be larger than when the speed of the engine slowed down so often.

"A year ago this plant was running poorly, the engine could not carry the load and the speed was so poor another boiler was thought of.

"The worst feature of the trouble was tight belts. After treating the belts, the new boiler was not needed and the plant has run all this winter without slowing down.

"This remarkable performance shows that intelligent use of Cling-Surface will accomplish good results. With proper application, Cling-Surface can't help but be of service."—Hubert E. Collins, Consulting Engineer, Astoria, N.Y.

Speed of shafts and friction load taken in silk mill of M. C. Migel & Co., Astoria, N.Y.

Shafts	Indicated horse power 22 1-10 *Speed Sept. 7	Indicated horse power 32 ‡Speed Oct. 24	Gain
Main	160 r. p. m.	160 r. p. m.	0 r. p. m.
No. 1 South	155 "	158 "	3 "
" 2 "	155 "	159 "	4 "
" 3 " East	158 "	159 "	1 "
" 3 " West	155 "	159 "	4 "
" 4 " East	157 "	159 "	2 "
" 4 " West	154 "	159 "	5 "
" 1 North	147 "	152 "	5 "
" 2 "	147 "	150 "	3 "
" 3 "	151 "	151 "	§ "
Friction load	11 horse power	9 horse power	2 horse power

* Before Cling-Surface was applied.

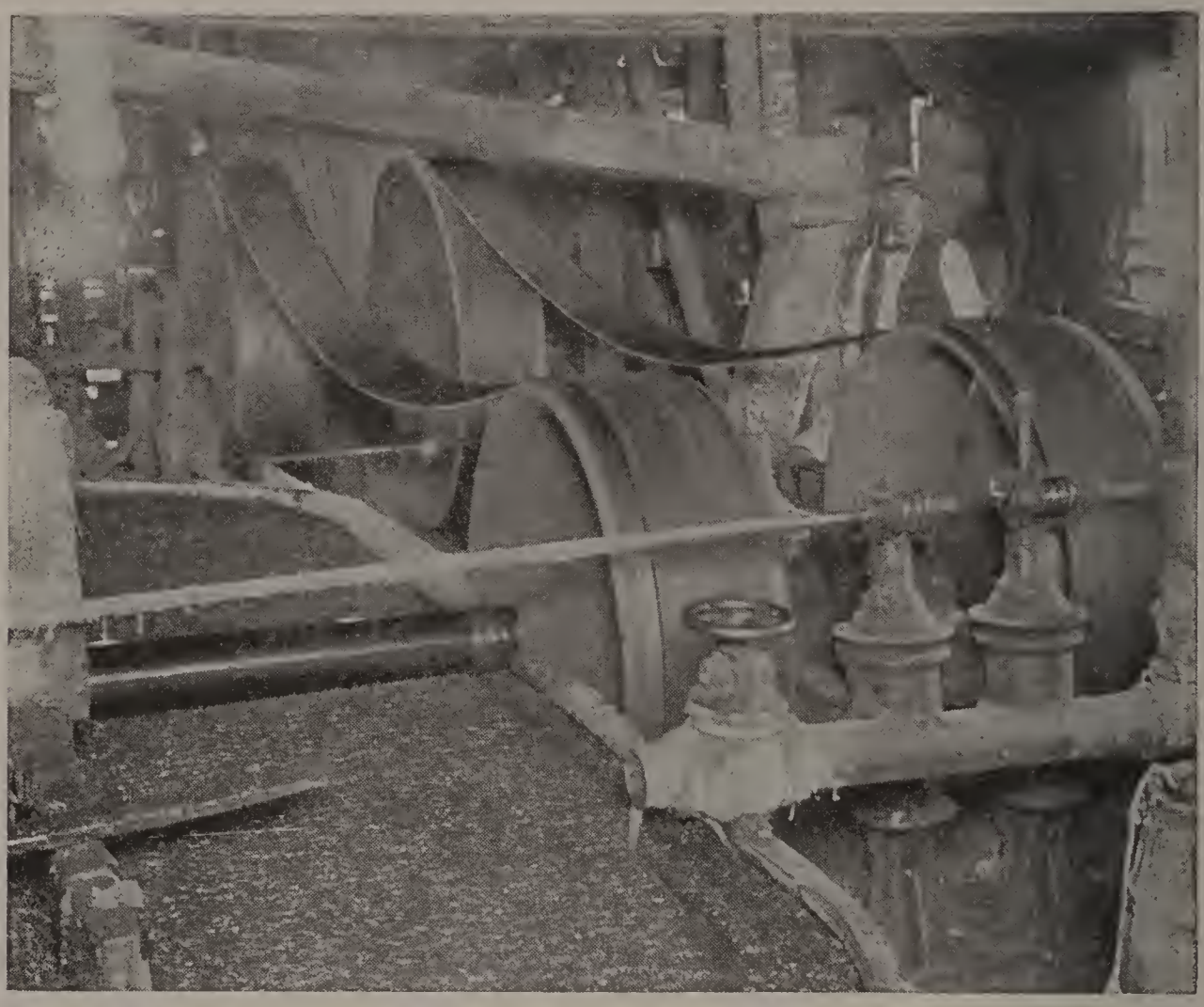
‡ With 50 per cent more load than when speed was taken September 7, 47 days after Cling-Surface was first applied.

§ Belt is badly laced, which accounts for no increase.

Cotton or canvas belts

Cotton or canvas belts may be of either of two constructions, woven like webbing or folded into a number of plies and stitched. The stitched belts are stronger than the woven, everything else being equal, because they are denser. A four-ply stitched belt has about the same tractive power as a single ply leather. Both forms are sold either plain, or filled and painted. Each of these will be considered separately, as their care differs somewhat. However, cotton belting of any type must be more thoroughly protected than leather to remain in good condition throughout a long life.

Outside of all consideration of belt preservation, proper care of any canvas belt will pay well in the increased amount of power transmitted. Where the belt is kept in prime condition it continues to transmit full load without the necessity of tightening to prevent slip. This in itself effects a big saving in decreased attention, less trouble from hot boxes, worn bearings and a



DriveR pulleys, 72-inch, and driveN, 48-inch diameter. Distance between shaft centers, 14 feet.

Two 12-inch Gandy painted canvas belts that transmit 40 horse power each and run with 27-inch slack without slip. Cling-Surface treatment was started here in 1900 in the Toledo (O.) Binders and Trunk Board Mill. The belts were made waterproof and carried full loads perfectly in spite of the wet and severe conditions under which they work.

minimized internal friction load. The possibilities of careful treatment of cotton belts are well illustrated in the accompanying photographs.

Ordinarily a four-ply stitched *canvas belt* should not be run over less than a six-inch pulley; a five-ply over not less than a nine-inch pulley; and a six-ply over not less than a twelve-inch pulley. Any diameters less than these may cause canvas belts to cut in making the short bends necessary at the pulleys. When filled with Cling-Surface, however, cotton or canvas belts are more flexible and smaller pulleys do less harm.

Plain canvas belts

Plain canvas belts are very low priced, but heretofore their use has been confined to uniformly dry places because in their natural state they are easily influenced by atmospheric conditions. Without special treatment they act somewhat like a clothes line—tight on damp days and loose on dry days. If left unfilled, a woven canvas belt, and most of them are woven, is apt to stretch a great deal and in doing so is reduced in thickness and width. A preservative waterproofing composition is of very great value in treating these belts in that the inner fibers mat down closer without the surface cracking and, by increasing the density, firmness, and weight of the belt, prevents this stretch to a considerable degree.

There are great possibilities in the use of these plain cotton belts, filled with Cling-Surface, in all sorts of wet places, or where low-priced belts are needed for rough work, as in mines, brick plants, stone works, saw mills, threshers, or in fact in any kind of work, outdoors or in, in all sorts of plants. The Cling-Surface fills these belts full, makes them pliable, yet firm, prevents all slipping, so they can be run slack and carry full load, and makes them absolutely waterproof, not only stopping the troublesome stretching and contracting from atmospheric changes, but makes them proof against all sorts of wet conditions. There will be considerable stretch *at first* even with Cling-Surface treatment, but much of the resulting slack can be left in to increase pulley contact. Such a belt is the most waterproof known and can be run *in* water without harm. It is actually more waterproof than a rubber belt, for the latter soon develops pin holes, admitting moisture but preventing its evaporation.

Cling-Surface treatment of a plain cotton or canvas belt is a very simple matter. The belt should be first cleaned, if dirty, in accordance with instructions on page 35 and then painted on the face, and more liberally on the back, with hot Cling-Surface. As the Cling-Surface soaks in very rapidly, applications to the inner or face side can be as heavy as for ordinary leather. The frequency of subsequent applications is the same as for ordinary leather. Some of our customers tell us that they find plain canvas or cotton belts when filled with Cling-Surface before being put into service in damp places ultimately more economical than any ready-to-use belting obtainable.

Test of plain cotton belting under Cling-Surface treatment

The following extracts are taken from the report on tests of Cling-Surface treatment on plain unpainted cotton belting, as made by Mr. E. B. Cary at Sibley College, Cornell University, Ithaca, N.Y.

"A cotton belt treated with Cling-Surface is much superior in

DriveR pulley, 56-inch diameter, 230 revolutions per minute. DriveN pulley, 34-inch diameter. Distance between centers of shafts, about 35 feet. Belt speed, 3360 feet per minute.

A 12-inch 6-ply plain stitched cotton belt, bought with the idea of taking the stretch out and waterproofing with Cling-Surface while new, and thus obtaining excellent service at lower cost than otherwise possible. The belt was put into 24-hour-per-day pumping service May 1, 1911, to carry 75 horse power and run so slack that the sides nearly touched. The initial stretch was taken out by taking up when the sides touched, and now the belt has settled down to doing uniformly good work and is not affected by the damp night air of the Louisiana plantation on which it operates. This belt originally cost $30.00 and the Cling-Surface for it $3.50. A painted belt of the same size could be obtained at no less expenditure than $52.29. The engineer now says that he would not trade the Cling-Surface-treated belt for any painted belt, and would not be without Cling-Surface even if he had to pay for it himself.

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efficiency, can be run looser, and runs with greater smoothness than a similar untreated belt.

"Data showed that the untreated belt had exhibited quite a little more stretch than the treated belt.

"The Cling-Surface increased the weight of the belt appreciably. It rendered the belt much more pliable, and, although applied at the surface, did not form a layer there, but seemed to penetrate the material and become a part of it. By the quality it gave, the roughness of the belt on the running surface partially disappeared and gave the appearance of a hard-rough surface which has been hammered down fairly smooth. The rough projections were flat-

tened and their surfaces were made even and smooth.

"In order to ascertain whether Cling-Surface rendered the belting waterproof, the effects of soaking the untreated and treated belting in water were tried. The belting which was treated with Cling-Surface was given two applications on both sides, thus giving it a complete coating. Four pieces of belting were used; a three inch, three-ply and six-ply, without Cling-Surface, and the same sizes with Cling-Surface. The pieces were all marked into twelve-inch lengths and were immersed in water for twenty-four hours. The untreated and treated pieces were put in separate pails where they were completely covered by the water.

"Upon removing them twenty-four hours later it was found that the pieces which had been treated with Cling-Surface were as soft and pliable as before and there were no signs that they had absorbed any water. When measured it was found that they were still of the same length. The water in which they had been immersed for twenty-four hours was as clean as at first.

"The water in which the untreated pieces of belting had been soaking was slightly brown, showing that dirt in the beltings had been dissolved. The pieces had been rendered somewhat more pliable by the water soaked up but were still quite stiff. The three-ply had shrunk a quarter of an inch in the twelve-inch length, while the six-ply showed a diminution in length of one-eighth of an inch."

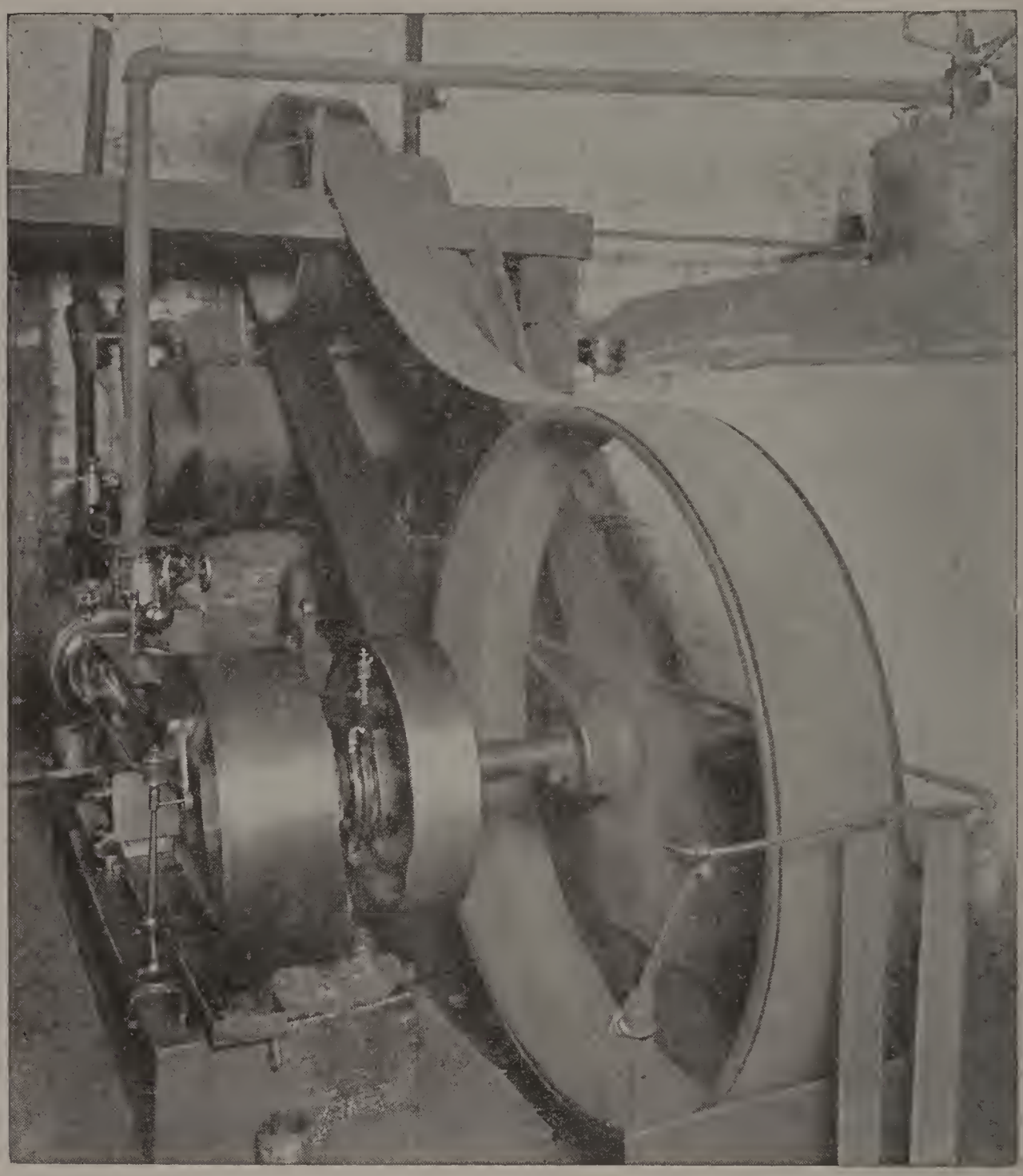
Painted canvas belts

Painted canvas or cotton belts, of which Gandy, Leviathan, Carton, Duke, Sawyer, Teon, Coronet, Scandinavian, etc., are examples, are used in much greater number than the plain type. (See illustrations on pages 12, 22, 27, 41, 42 and 68.)

This form is filled with a preparation usually of some gummy oil to prevent stretching and for waterproofing, and is covered on the outside with one or two coats of red paint, thus forming, while new, a good and comparatively cheap belt for rough hard work. When run with proper slack this kind of a belt for a time gives splendid service without attention, the length of time depending upon the character of the work, the load, the amount of slipping and the exposure. The painted canvas belt is fairly waterproof when new because the paint on the outside and the gum in the filler naturally keep the water out. But after a painted belt has been in use for some time, the paint wears or chips off the inner surface, leaving the pores more or less open. If no protective measures are taken the gum in the fibers gradually hardens and the belt becomes stiffer. At this stage cracks are apt to appear upon the back of the belt, working in from the edge.

As the belt cracks in this way the fibers are likely to break as well as become exposed to moisture. These conditions need not be serious if given proper attention, but if neglected are bound to make trouble.

Water cannot get out so easily as it can get into the minute cracks and if its entrance is permitted at all the fabric sooner or later rots. The original preservative and waterproofing materials begin to fail from age and as they do so must be replaced or the belt cannot long withstand the strains of service and exposure to destroying influences. Something must be applied which



DriveR pulley, 72-inch diameter, 200 revolutions per minute. DriveN pulley, 42-inch diameter. Distance between shaft centers, 11 feet. Belt speed, 3770 feet per minute.

A 12-inch Gandy (painted canvas) belt, Marion (Ind.) Stove Co., that has been treated with Cling-Surface for 10 years. This belt carries a load of 50 horse power and although it runs with 17-inch slack there is no slip.

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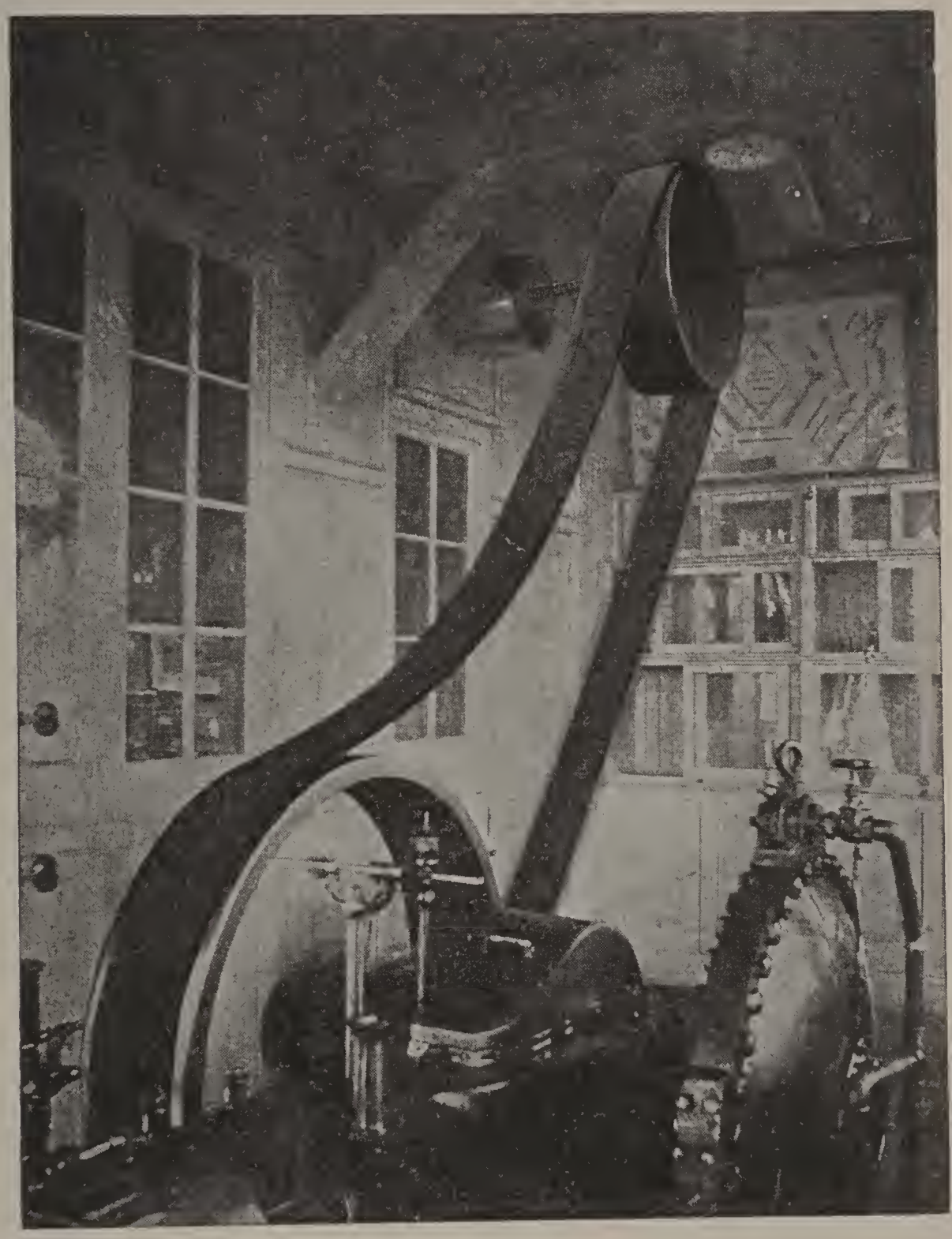
will penetrate through the cracks and openings of the paint and get down into and among the fibers of the cotton to soften the gum and fabric and keep the belt pliable. This substance to be effective must not itself be gummy and yet waterproof the belt and keep its surface in condition to prevent slip.

Cling-Surface treatment will fulfill all of these requirements perfectly, but as these belts are less porous than the plain type, they absorb the Cling-Surface less rapidly.

Before applying the Cling-Surface, a painted canvas or cotton belt had best be cleaned as described on page 34.

The back can be treated to good advantage, for the film of Cling-Surface on a new belt prevents hardening and drying of the belt filling. Old belts from which the paint has worn off and which are cracked or frayed are greatly benefited by light applications of Cling-Surface at intervals and heavier in any cracks. Repetition of this treatment when the previous coat has been absorbed will do old belts of this type much good.

The face must be treated with care not to use too much Cling-Surface at a time, because the paint and filler hinder quick penetration. Only enough



DriveR pulley, 49-in., and driveN, 34-in. diam. Distance between shaft centers, 8 ft.

An 8-inch painted canvas belt in the shops of the University of Nevada, showing the slack after Cling-Surface treatment. This is the belt upon which the test report on page 74 was made.

Cling-Surface should be applied to bring a *medium* stain on the pulley face (see tints, inside front cover,) and the applications should not be oftener than every other day for the first two weeks. After that the Cling-Surface can be applied at intervals of one, two or three weeks or oftener as conditions and good service demand.

The increased load transmitted after Cling-Surface treatment of the weak face of painted belts that are old, cracked or torn—the after results of harmful dressings, or injury from old slipping and burning—may tear off the weak or loose surface areas. In this event, the loose useless canvas should simply be removed and the treatment continued on the sound canvas underneath, or the belt may be turned over to bring the stronger side next the pulleys, and the Cling-Surface applied accordingly.

For the treatment of painted belts to operate in dusty places, the hints given on page 48 will be found effective.

Test of a painted canvas belt under Cling-Surface treatment

An eight-inch painted canvas belt (shown on page 73) that had been in use but one month was treated with hot Cling-Surface, put on the pulleys slack and with rawhide lace joint, and made to pull a load of 50 horse power in the shops of the University of Nevada (Reno, Nev.). The driving pulley was forty-nine inches in diameter, the driven, thirty-four inches and the distance between centers eight feet. The results as reported to us by Mr. Jas. G. Scrugham, Associate Professor of Mechanical Engineering, were as follows:

Test No.	R. P. M. Driver	R. P. M. Driven Actual	R. P. M. Driven Calculated	Slip, R. P. M.	Per cent of slip	Load
1	288	414	415+	1	.24	¼
2	293	418	422.2+	4.2	1.00	½
3	297	421	428+	7	1.63	Full

These tests were made where the air was exceedingly dry. The increase in driving speed during the progress of the tests was due to raise of boiler pressure and corresponding increase of engine speed. It should be noted that under full load the indicated slip was only 1⅔ per cent, or, in other words, there was really no slip at all, since slip up to 2 per cent is mainly belt creep.

Tar-filled belts

Canvas belts filled with Stockholm tar correspond closely to painted canvas belts in service capabilities, but usually make trouble on account of the sticky nature of the tar, which is apt to come out and lump on the pulleys. These lumps must be removed as soon as they form. Much of the objectionable surface tar can be dissolved away by application of the washing mixture described on page 35, or by turpentine, and then the belt can be put into the best possible condition by treatment with Cling-Surface. It is preferable to take the belt off the pulleys when possible and immerse it bodily in the cleaning mixture, but it should be allowed to dry out thoroughly before applying the Cling-Surface.

Cling-Surface treatment of the front and back of the belt as explained

on page 33 will gradually decrease the amount of lumps as the Cling-Surface changes the nature of or displaces the tar, and if persisted in will produce a pliable, waterproof belt, clean and good for a long life and for slack running.

Camel's-hair belts

Camel's-hair belts may be woven largely of hair or with a cotton face and like cotton belts are sold both plain and painted. In general they are serviceable for the same purposes and require about the same care as woven cotton belts. Their preservation by Cling-Surface treatment is equally desirable. The efficiency imparted by Cling-Surface treatment is illustrated on pages 14 and 15.

Plain camel's-hair belts may be painted liberally with hot Cling-Surface, as they absorb very rapidly, and the application may be repeated with advantage two or three times the first week. During the first week the inner face can be treated once or twice daily, depending upon how fast it absorbs the Cling-Surface. After the first week, treatments of both face and back can be extended through longer intervals until once every six to eight weeks is enough.

Just as with plain canvas, many Cling-Surface users get their camel's-hair belts unpainted, waterproof them by preliminary Cling-Surface treatment and thus get the same advantages as explained on page 69. Our customers also often take new painted camel's-hair belts, soften the paint and wash it off with turpentine and then partially fill the belt with Cling-Surface before putting into service. The paint is only a finish which does the belt no good except possibly while new, and will only lump off on the pulleys.

The application of Cling-Surface to old painted camel's-hair belts seldom involves consideration of the paint (page 71), as that has usually worn off. However, a washing with the cleaning mixture before the Cling-Surface is applied is worth while.

Rubber belts

Rubber belts consist of layers of canvas, alternating with layers of rubber and covered with a rubber skin. The strength is chiefly in the canvas, a four-ply rubber belt being about equal in tractive power to a single ply leather belt. The rubber is chiefly intended as a waterproofing protection. The quality of rubber belts ranges from the best to very poor.

Unfortunately the demand of other industries has made the price of rubber high, and has tempted some belt manufacturers to use too little real rubber and too much filler. A certain percentage of filler is necessary to give the rubber body. This filler is of an earthy character, and when used in excess not only lessens the strength of the rubber and the adhesion of the plies to their neighbors, but also causes the belt face to polish quickly and slip. The earthy particles soon wear bare of rubber and slip, while an inferior rubber belt is weak. The face may soon burn or tear and any of the plies may loosen up and separate under the stress of bending and load. In some cases, this is a local blister, while in others it is more extensive. As a belt ordinarily slips when the heavy stresses come, thus relieving itself (and incidentally wasting power), some weak places may exist for a considerable period and not be especially or at all apparent.

Further, an untreated rubber belt, no matter how good, is actually waterproof only while new. Any soft rubber subjected to atmospheric exposure

DriveR pulley, 3-foot diameter, 235 revolutions per minute. DriveN pulley, 6-inch diameter. Distance between shaft centers, 16 feet. Belt speed, 2210 feet per minute.

A 6-inch 4-ply rubber belt (Hoyt Bros., Ware, Mass.) that offers a severe test for Cling-Surface treatment. The planer and traction engine work all year around. So much dirt, snow and water get on these belts that they were formerly hard to keep in running order, but not since Cling-Surface treatment, which has saved much money for this firm during the past 12 years.

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ultimately dries out, changes its chemical composition and becomes brittle. In belting, the rubber face fills with pinholes and minute cracks, the latter due to the bending action. These surface openings admit moisture much more readily than they permit of its evaporation, hence unless protective measures are taken, the canvas interior is apt to rot.

Rubber belts neither should nor do absorb Cling-Surface at all, but the action of light applications of Cling-Surface is a decided advantage in filling up surface holes, maintaining water-tightness and enabling the belt to be run continously easy or slack and pull full loads. The Cling-Surface unites with and refreshes the surface rubber, giving it new life and a new and perfect grip on pulleys, without any stickiness. It also covers over the fine earthy particles, destroys their polished gloss, and thus turns the slipping into a gripping face. The extent to which Cling-Surface maintains these benefits is evidenced by this comment by a prominent maker of rubber belting:

> "We are frequently asked to furnish a belt to transmit a given horse-power. Ordinarily it is not safe to send out a belt on a higher coefficient than one horse-power for 1000 feet per minute per unit of width (one inch). This is very low and if we could be assured of Cling-Surface treatment, we could send out belts on a 500-foot base, or a coefficient of two horse-power per 1000 feet per minute for each inch in width. There is an economy of operation in this as well as economy of first cost since the dead load of the lighter belt is much less."

Rubber belts, preparatory to Cling-Surface treatment, should be washed with only soap and water or can be given a few treatments with hot Cling-Surface, which will gradually soften the dirt, which may then be carefully scraped off. They may also be turned over if the back is cleaner than the face. Benzine, gasoline (petrol) and cleaning mixtures based on these, should never be used on rubber belts, as they dissolve the rubber. *The treatment must be cautious, for it is easy to use too much Cling-Surface on such*

DriveR pulley, 30-inch diameter, 280 revolutions per minute. DriveN pulley, 24-inch diameter. Distance between shaft centers, 15 feet. Belt speed, 2200 feet per minute.

A 10-inch 6-ply rubber belt (Boyd's Trunk Co., Pittsburgh) which was formerly run tight and slipped badly, but under Cling-Surface treatment runs with 8-inch slack under full load and never slips.

a non-absorbent body. The back should get only enough Cling-Surface occasionally to fill the surface pinholes or any cracks, and the face should be treated only with an almost clean brush to insure light applications. The brush should be scraped on the can until nearly free of hot Cling-Surface and worked lightly across the belt face while the belt is running slowly. All parts of the face should pass under the brush, which should be sparingly refreshed at intervals, and the application stopped as soon as pulley shows light stain as shown in scale of tints, inside front cover. The application should not be repeated oftener than every other day for a week or two, then weekly for a month, and afterwards at longer intervals only as needed to make the belt do its best work. The hints under "Dusty Conditions," page 48, should prove helpful in this regard.

With Cling-Surface, properly applied in small amounts to a rubber belt, the day of slipping and shirking is over. The belt *must* carry all the load demanded. The increased strain due to such perfect transmission under Cling-Surface treatment may cause the rubber to tear in spots on a weak or on an old rubber belt where the face has lost much of its early hold on the canvas beneath. The use also of many cheap, thin, oily dressings separates the rubber from the canvas. Whatever the original cause may be, in such event Cling-Surface should not be blamed — *the belt simply fails because Cling-Surface has not failed.*

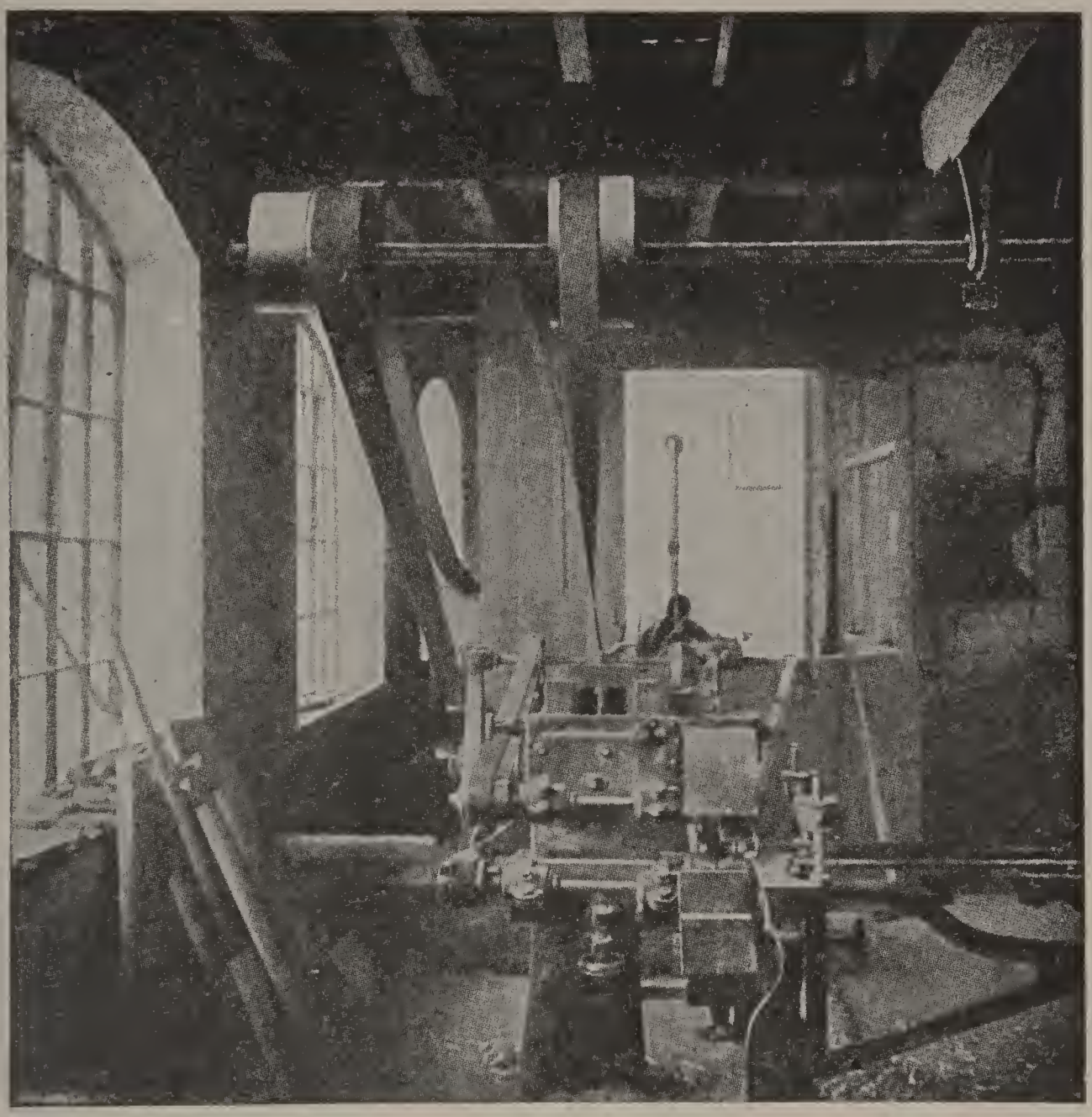
As a matter of fact the belt is as good or better without the worthless surface skin, for the skin polishes and will not pull, has no initial strength and is not even waterproof, being full of pinholes, while when it is off, Cling-Surface can be applied to the canvas underneath, which *will* pull, *has* strength and quickly becomes really waterproof. The removal of the useless loose rubber and spent fabric involves no loss. The Cling-Surface, by stopping the slip and power loss of the past, makes the belt do full duty, and failure is certain evidence that that part of the belt is not adequate to its work.

Balata belts

Balata belts of various makes are almost identical in construction with those of rubber, save that some balata composition is substituted for the binder and facing and as a rule impregnates the fabric better. They have the same or better water-tightness, and are much used abroad where they are cheaper than leather. Balata is a more tenacious gum than rubber, hence the plies are more firmly cemented together and the surface skin also holds better.

A balata belt is stiffer at first than a rubber belt and if not constantly used, tends to grow worse. Samples of balata belts under our observation have grown hard as a bone in time. The practical absence of stretch in service is often a cause of difficulty with a balata belt, and as there is little natural pliability the belt must ordinarily be put on the pulleys very tight.

Balata belts are bound to slip under such conditions, and as the surface of the belt has naturally a high coefficient of friction and is not naturally slippery, a high degree of heat is sometimes developed. The heat warms or melts the balata on the surface and between the first two plies. This melting weakens or separates the surface skin of balata between the first two plies. In fact this heat has been known to become so great that it has extended right through the belt and made the balata on the back come up in tiny bubbles. One of the largest manufacturers of such belts abroad,



A 5-inch balata gas-engine belt in the plant of C. Griffiths, Stonebridge, England. This belt runs between pulleys 13 feet apart and is subject to sudden changes of load. Since treatment with Cling-Surface, it runs quite slack and carries full load without slipping.

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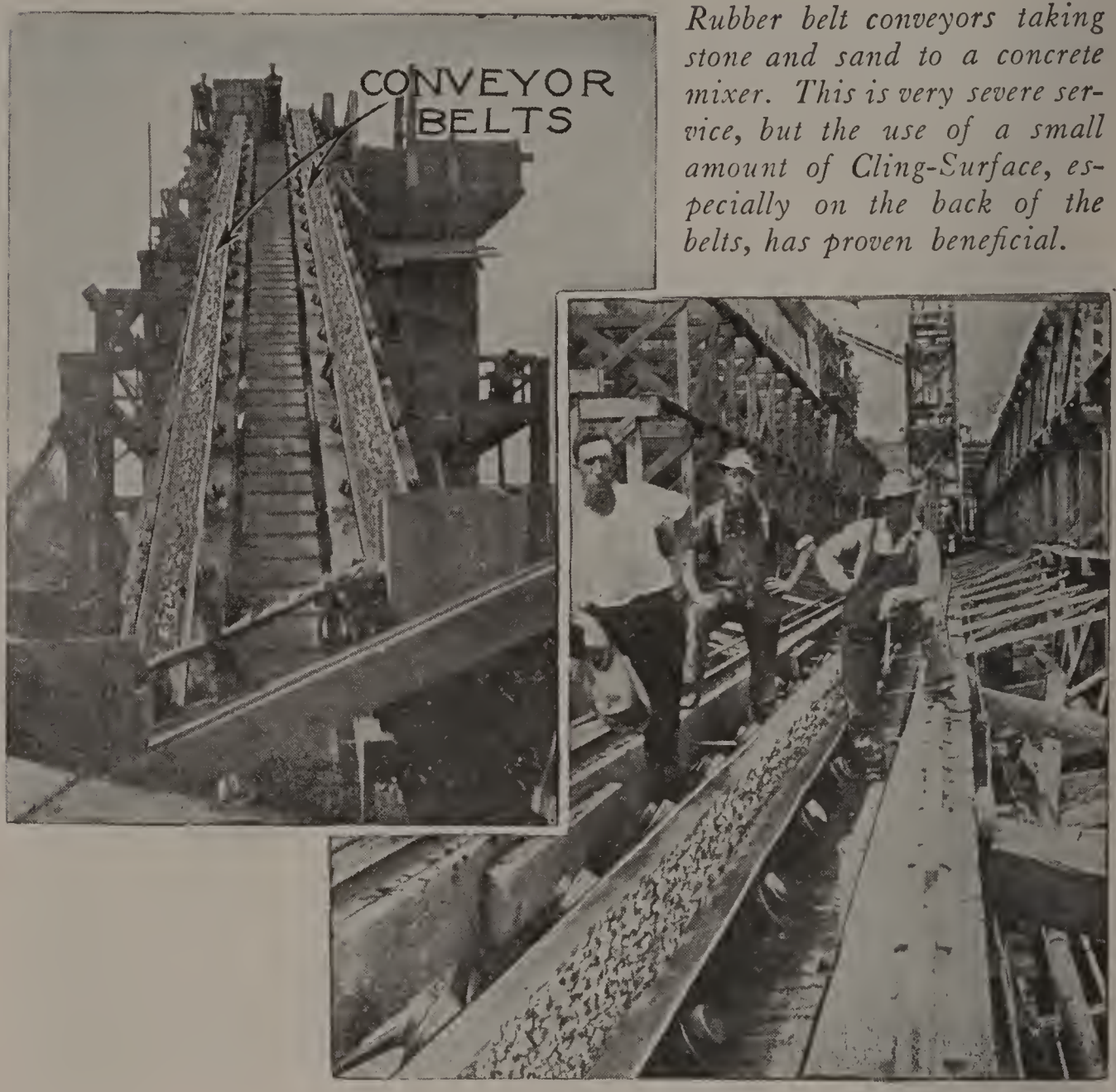
in case of complaint regarding the disintegration of a balata belt, cites this feature of bubbles and puts blame on allowing the belt to slip.

Cling-Surface therefore is beneficial for balata belts, as for rubber belts, in *small applications at a time, much less than for leather.* It will properly stop slipping without harming the belt, if used correctly, but will make the belt slip if used too freely. The advantages, nature and frequency of Cling-Surface applications are practically the same as for rubber belts (page 75).

Cling-Surface, however, cannot make good the effects of past abuse or damage from slipping or heating, and cannot be held accountable when, by forcing the belt to do the work demanded of it, makes apparent such defects.

Weak or burned surfaces, which the increased stresses may lift, can be removed, and the treatment continued on the next ply with very satisfactory results. Cling-Surface has been used for years for balata belts abroad and to some extent at home and in Canada with entire satisfaction.



Rubber belt conveyors taking stone and sand to a concrete mixer. This is very severe service, but the use of a small amount of Cling-Surface, especially on the back of the belts, has proven beneficial.

Conveyor or bucket belts

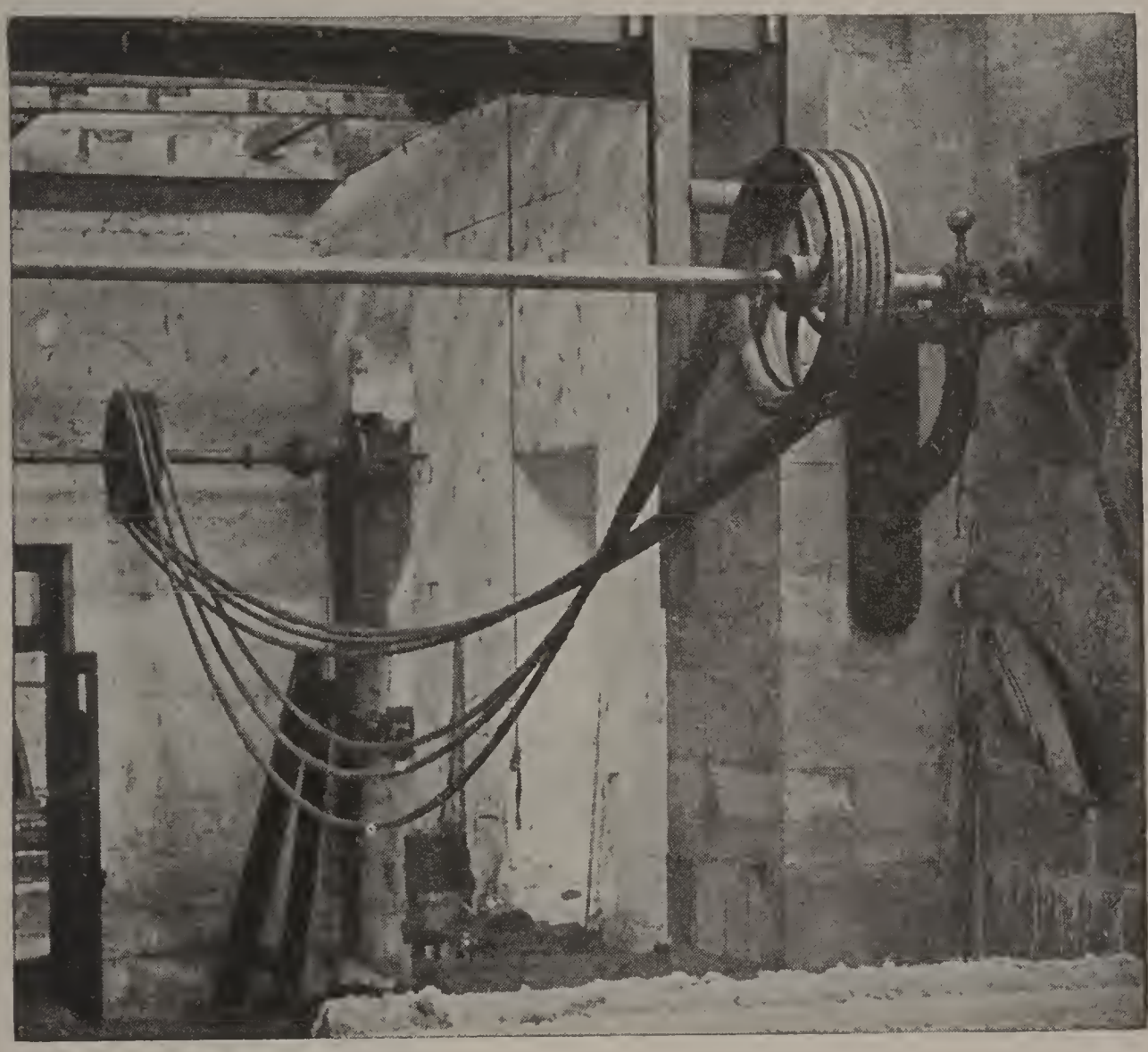
Conveyor belts, plain or with buckets riveted upon them, are made of so many different materials, carry loads of such wide variation in nature and amount, travel at such a wide speed range, are so badly bent throughout their length and are subjected to such a diversity of surrounding conditions that a general discussion would be beyond the scope of this book. It is safe to say, however, that the constant bending over rollers, pulleys, sheaves, etc., the weight of load, the surrounding dust, dampness, the possibility of chemical action from contained material, etc., either separately or collectively, demand at least preservative treatment of the conveyor belt if not an aid to positive action and power economy.

Cling-Surface treatment can be depended upon to keep such belts in better physical condition and offer every aid in the way of maintaining a non-slipping surface.

It is a common complaint in chemical fertilizer and similar plants, using conveyor belts with buckets riveted upon them, that the action of fine dust settling around the rivets causes rapid corrosion and rotting away of the belt, thereby loosening the buckets. This chemical action will be materially reduced and the belts last much longer if hot Cling-Surface is applied to them freely while new, particularly around the rivets in contact with the belt.

Rope Drives

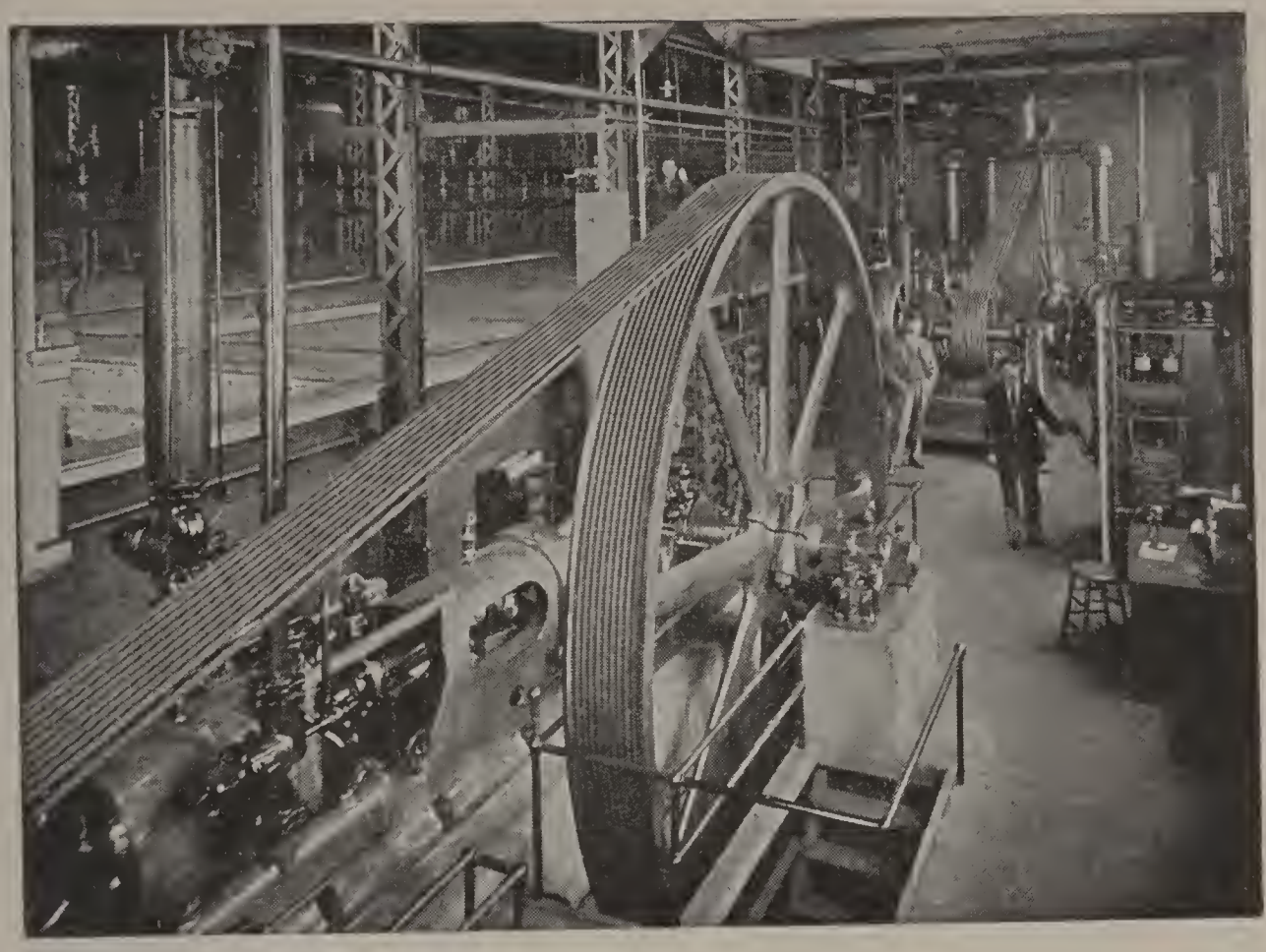
Rope has a much wider range of application than belting, as it transmits power economically through any distance from a few to 400 feet, around angles, between floors, and in fact between almost any two shafts regardless of their position with reference to each other. One main rope drive can be made to carry power to a number of buildings or floors, the ropes all passing around the driving pulley and dropping off at the driven shafts as each requires. Ropes are low in first cost, run steadily, noiselessly, can be economical in installations of any size up to about 4000 horse power each and produce no electrical disturbances. A rope drive takes less width than a belt drive, and further, owing to the much higher speed of travel permissible with rope, the total efficiency of the rope drive may be much increased over



Rope drive in the Parramatta Woolen Mills, Sydney, N. S. W., which shows how slack an English system drive may run after Cling-Surface treatment. It should be noted that although re-splicing has been postponed until long after the slack side has gone down through the driving side, each rope of the latter assumes an equal amount of the load. The exaggerated slack is beneficial rather than otherwise in that the pulley wrap has been greatly increased.

Rope drive treated with Cling-Surface and run in the open on the roof of a malt house in Buffalo for five years. The preservative effect of Cling-Surface is shown in the lower illustration.

Section of rope taken from the outdoor drive shown above, after five years of Cling-Surface treatment and constant service while exposed to the dampness, winter cold and storms of the lake regions. Note that the fibers and core had remained in perfect condition up to the time when plant changes necessitated the removal of the drive.



DriveR sheave, 38-inch diameter, 375 revolutions per minute. DriveN pulley, 22-foot diameter. Rope speed, 3730 feet per minute.

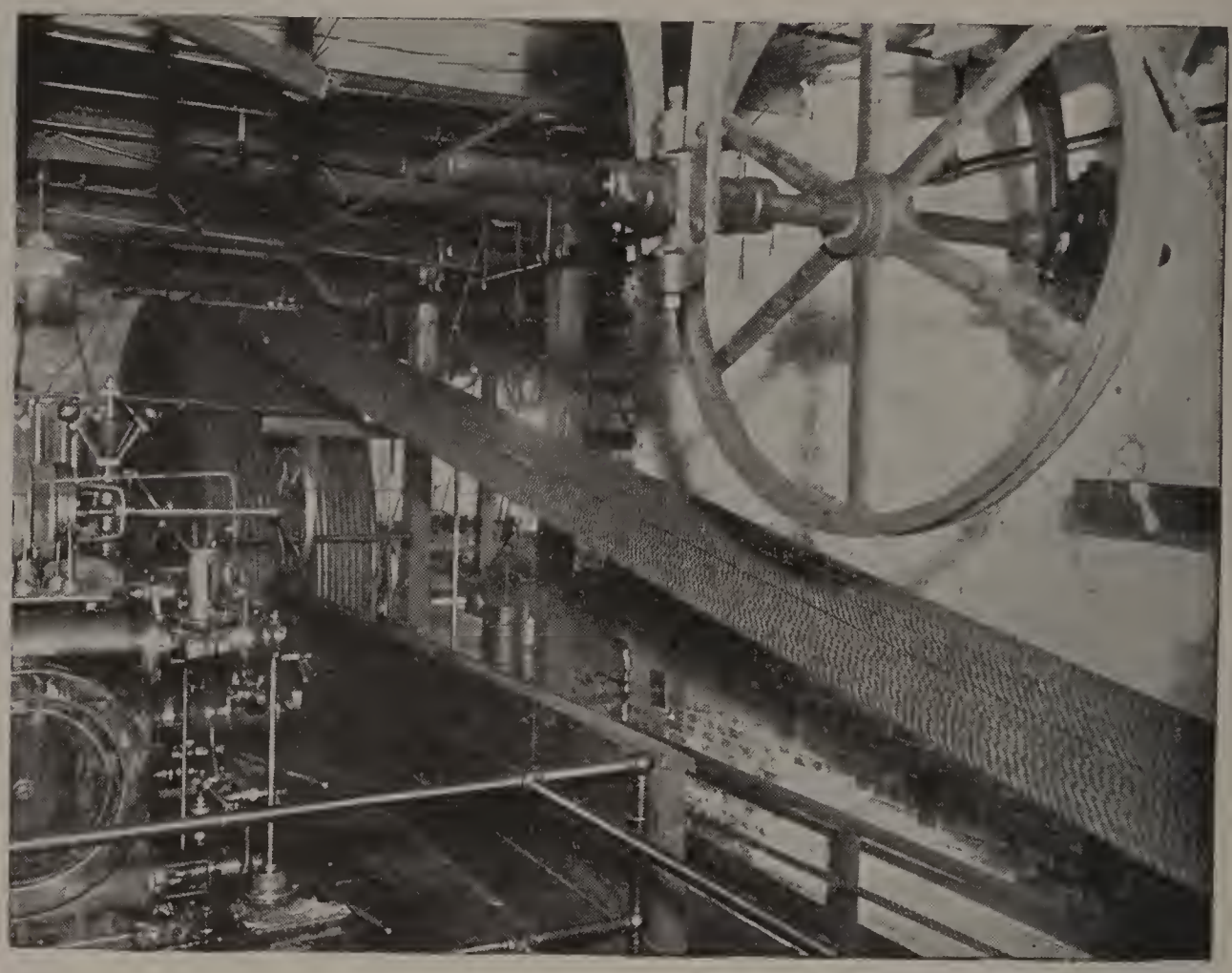
Two ten-rope (1⅛-inch manila) American system drive from 200-horse-power induction motors to ammonia compressors in the plant of Crystal Ice & Storage Co., Buffalo, N. Y. This rope has averaged continuous 24-hour service for over 300 days per year for the past four years and often carries 20 per cent overload. Previous to Cling-Surface treatment, a 400-pound weight carried on the tension carriage was necessary to prevent slip, but now 100 pounds of this weight have been removed, the ropes are running easy and there is no more slip.

---

that of the belt drive and the wear and tear on the shafting reduced, owing to the decreased weight of the driving pulleys.

Rope drives are of two types: first, the English or Multiple system in which there is a separately spliced rope for each groove in the sheaves, and, second, the American or Continuous system in which one long rope is wound round and round the sheaves and has ends spliced slack to form a loop in which a tightener sheave and weight are hung to regulate the tension. Both forms have advantages under specific conditions. Rope of the same diameter will do an equal amount of work on either system.

The multiple system is preferable for large drives, for, if one rope breaks, the others can continue to pull the load until a convenient time for repairs. The best results are secured from this system where not exposed to the weather and where the shafts are parallel, and as the rope always travels in the same direction, it is apt to be longer lived than in the continuous system.



DriveR sheave, 15-foot diameter, 90 revolutions per minute. DriveN sheave, 8-foot diameter. Distance between shaft centers, 40 feet. Rope speed, 4240 feet per minute. 1½-inch manila driving ropes (American system) that have had Cling-Surface treatment for over a year. Tonawanda (N. Y.) Board & Paper Co. Drive No. 3, which is one of several large drives so treated has 14 ropes, all flexible, in perfect physical condition and waterproof. The engine develops 600 horse power.

The multiple system also costs less to install and by getting at the start, sheaves with a few additional grooves, the addition of a few more ropes for power increase is an easy matter. The continuous system is preferable for drives having turns, for vertical drives and in fact for drives in any complicated position. The tension carriage must be so located that a backward and forward or up and down movement of the carriage is practical to automatically govern excess slack from varying load or stretch in the rope.

The transmission ropes most used in America are of manila hemp, while in other countries cotton and occasionally rawhide and even hair ropes are found. Transmission ropes vary from one-half to three inches in diameter, and may have from three to six strands, the four and more strand ropes often having a special core. The three-strand ropes make short turns well but are less serviceable than four or more strand ropes, hence should be used only on lighter work. Ropes of four or more strands have a greater proportionate cross-sectional area of material and conform better to the grooves in which they run. Cotton ropes are the softer and more flexible, hence give best service on sheaves of comparatively small diameter, but owing to inferior strength of the fiber are perhaps less to be recommended for severe duty.

Transmission ropes show their first and worst wear on the inside, and for this reason an old rope apparently in good condition may be entirely unfit for service. Constant bending around the pulley sheaves causes the internal fibers, if unprotected by some lubricant, to rub and grind harshly against each other. The fibers of one strand slide upon each other, and the strands in like manner slide upon each other and the core. Where moisture is permitted to penetrate the rope, the center ultimately rots, while if left dry, it grinds into a fine powder. To counteract this tendency, some manufacturers lubricate the core, which is quite advantageous, but as the rope ages the lubricant must be replenished. Formerly tallow was offered as a rope

Rope drives treated with Cling-Surface for over a year and running out-of-doors at the plant of the George Stratford Oakum Co., Jersey City, N. J. Some of the weights have been removed from the tension carriage since Cling-Surface treatment and the transmission power is better than ever. The rope is waterproof and pliable.

lubricant, but this develops a harmful stearic acid and dries out, leaving the rope core hard and brittle.

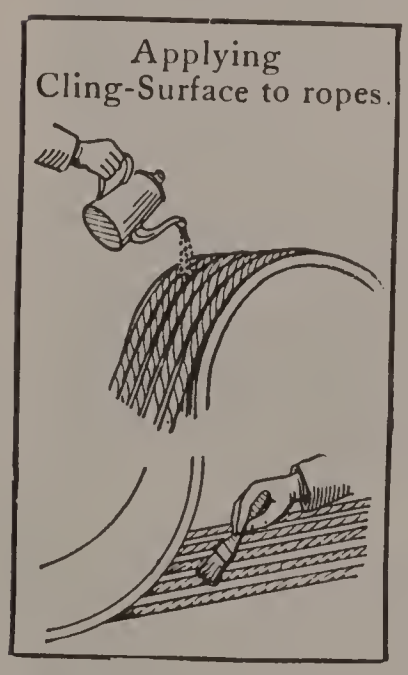
Cling-Surface treatment offers an ideal means of rope preservation, as the Cling-Surface works into the rope, mats down the surface fibers to a form which conforms best to the sheaves and penetrates and surrounds each internal fiber with a preservative lubricant. The fibers are thus made to work in real oil bearings, free from internal friction and chafing, while the whole rope is kept pliable, firm and absolutely waterproof. A rope filled with Cling-Surface can be run out-of-doors or in any sort of wet surroundings, will not slip even if run easy or slack and will invariably outlast an untreated rope, for the Cling-Surface will not be washed out on exposed drives.

Cling-Surface in ropes running on either multiple or continuous systems, therefore, renders resplicing a necessity of rare occurrence.

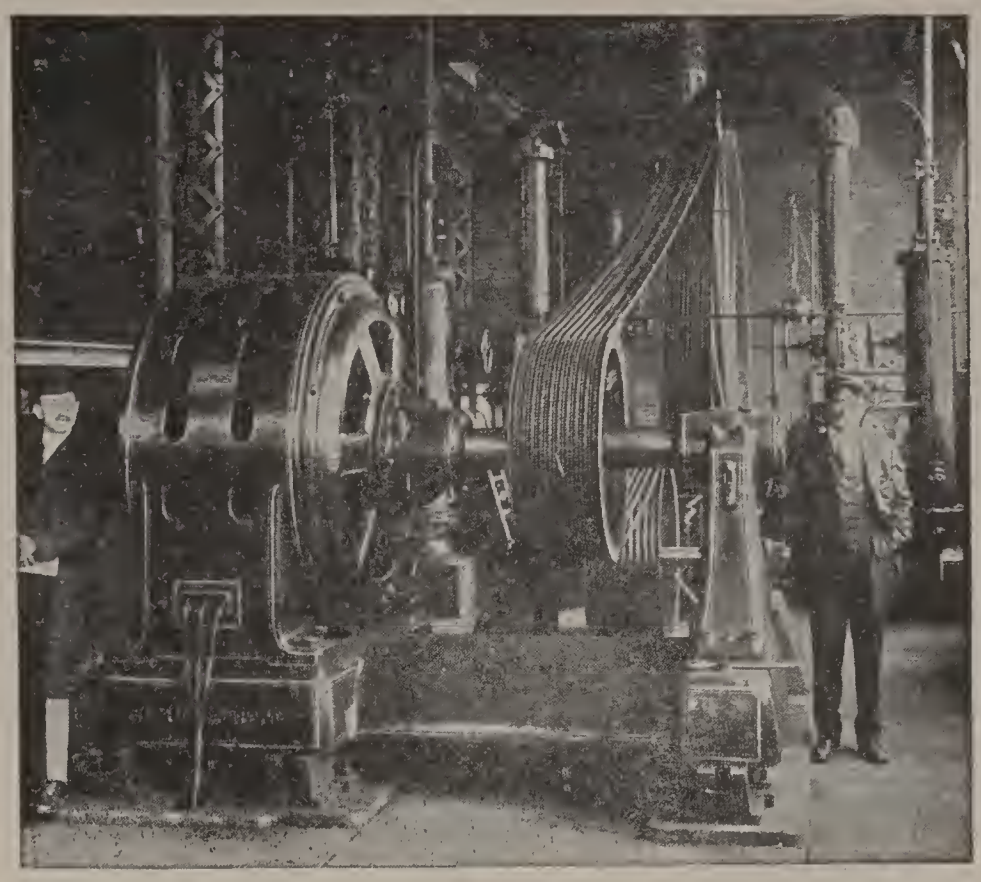
Cling-Surface treatment of ropes running on the multiple system equalizes the tension among the individual ropes through its prevention of slip and thus compels the best load distribution in spite of the ropes stretching or loosening up unevenly. The absence of slip permits slack running and as the rope is also rendered impervious to weather conditions, the usual troubles due to tight running and contraction of the ropes in wet weather are thus doubly prevented.

Cling-Surface treatment of ropes running on the continuous system permits the removal of much weight from the tightener and tends to reduce the "differential" by keeping the rope at practically uniform ease at all points. The exact amount of weight on the tightener carriage must, of course, be determined by conditions peculiar to each drive, but common sense dictates that this weight should be kept as low as consistent with smooth running. Only enough weight should be put on the tightener carriage to keep the rope from jumping the grooves. A prominent rope manufacturer states that any rope will do but a fixed amount of work in given time, and that the addition of surplus tension, while giving greater adhesive power, only makes more strain that unnecessarily shortens rope life.

In the application of Cling-Surface to ropes, the cleaner they are to start with the better, but as it is often not possible nor practical to clean ropes, they must be taken as found. Ropes thickly coated with tallow or wax and graphite can hardly be cleaned nor will Cling-Surface easily penetrate, hence Cling-Surface treatment of such is not as beneficial. On manila ropes the hot Cling-Surface should be poured in a thin stream from a coffee-pot. It should be applied while the ropes are running *slowly* and near where the ropes enter the upper arc of the sheave, because at this point the strands tend to open. Part of the Cling-Surface runs into the groove but is taken up on subsequent contacts. In addition to or in place of this method, hot Cling-Surface may be painted onto the *slowly moving* ropes just where they enter the groove at the bottom of the pulley. The teapot method is better, but either or both can be used. The treatment may be continued as fast as the Cling-Surface works into the rope, repeated at



Applying Cling-Surface to ropes.



Ten 1⅛ in. 4-strand manila rope drive from a 200 h. p. motor driving 54 r. p. m. ammonia compressors. Before using Cling-Surface, about 400 pounds weight was necessary on the tension carriage, and even then there was slip. Since using Cling-Surface this weight was reduced about 25 per cent., slipping stopped and now ropes run easily.

intervals of three or four days for the first two or three weeks and then extended over longer intervals.

In splicing ropes after Cling-Surface has been used, the ends should be unlaid and soaked in gasoline or naphtha, or even turpentine, which dissolves the Cling-Surface and leaves the fibers clean.

Cotton ropes absorb more Cling-Surface than do manila ropes and more rapidly until filled. They may with care be treated daily for two weeks, then extending the intervals to once every month or two as needed. Inasmuch as the objections thus overcome and the other advantages of Cling-Surface treatment here are similar to those for plain cotton or canvas belting, reference to the chapter on this subject, page 69, should be helpful.

Rawhide ropes should have very little Cling-Surface at a time and less often than cotton or manila, just enough to stain pulley grooves a very light oak color at an application. They absorb Cling-Surface so slowly that an excess may cause slipping. Hair ropes should be treated the same as manila.

Ropes on mechanical stokers

Ropes used on mechanical stokers are frequently the cause of much trouble. The heat of the furnace and trying conditions of the work cause quick wear, and much slippage occurs if the rope is not always at extreme tension. If these ropes be well painted with hot Cling-Surface and hung up in a warm place, so that the Cling-Surface may be absorbed before putting the ropes on, they can be run with considerable slack and do their work better than if tight, and will last many times longer than if untreated. Treatment of stoker ropes already running is same as for manila ropes, page 86.

Other methods for improving belt transmission

The following are mentioned, not as rivals of Cling-Surface in scientific belt and rope management, but because of their occasional use by men who are sincerely endeavoring to do what is best for mechanical efficiency and for their belts. Such men, we believe, are desirous of being posted on what objectionable features exist in some of the other theories and materials employed and would prefer to have this additional information.

Neatsfoot oil. This has been known for years and has much to recommend it for some treatments of leather, but the benefits show their value rather less in belt service than in other uses to which leather is put. Neatsfoot oil is not gummy, hence it keeps the leather pliable and prevents drying or cracking. The disadvantages and limitations are that it is to a certain extent volatile, it contains more free fatty acid than Cling-Surface does, and because it is a liquid oil, tends to increase stretching and to make leather too soft for best transmission purposes. It does not give the pliable, mellow density and strength that Cling-Surface with its heavier body does give, nor does it prevent slipping except in so far as a pliable belt slips less than a dry, hard belt. A belt treated with neatsfoot oil cannot be run slack under full load with the true advantages of slack running. Cling-Surface will be found to do all that neatsfoot oil will do and very much more besides.

Castor oil or linseed oil. These vegetable oils are not anultimately economical treatment for belts, even though frequently used and appearing to give a degree of satisfaction. They are of the gummiest of commercial oils, and the gum in solution is carried in and among the belt fibers as far as the oil penetrates. The liquid parts of these oils slowly dry out and leave the gummy elements which continue to stiffen and sooner or later become hard enough to crack. When these elements do crack, the belt fibers crack with them. This is the explanation of the fine transverse cracks, particularly across the backs of belts which have had initial or subsequent treatment with castor or linseed oil. It is these same gummy elements that make a belt so treated look slick and smooth, and, in a measure, lessen its tendency to slip. Both of these oils also decompose into harmful fatty acids. Proof of the decomposition of castor oil is obtainable by placing some in an uncorked bottle, setting this in strong sunlight or in a warm place and in time observing the changed appearance.

Soap, rosin, printers' ink, etc. These are all used for belts and are all harmful even though they give temporary relief from the worst of the slipping. Rosin or any resin is well known to dry out the belt and cause it to become husky, lifeless, polish up, and subsequently crack on the surface. (See page 5.)

Printers' ink contains rosin, gummy oils and varnishes, which is the chief reason why it is used. Printing ink for its legitimate use is supposed to dry within 24 hours, and continued application to belting builds up an objectionable coating on belt and pulley surfaces.

Soap gives a fine, smooth face to a belt, but many soaps contain rosin, while all contain more or less free alkali, which slowly destroys the natural oils and deteriorates the fibers of the belt fabric.

Stick or semi-solid treatments. Manufactured preparations in solid form, even though containing no harmful ingredients, cannot be beneficial to belting, because it is impossible for the solid material to penetrate the belt. It consequently must remain on the outside. The belt receives none of the food it requires to do best work and last, even though the material contains such food.

In general. No preparation should be used on belting without complete assurance that it contains not more than 50/100 of 1 per cent of free fatty acid; that it contains no rosin nor any resin, nor rosin oil; that it contains none of the gummy, sticky oils or varnishes; no soap; no naphtha nor other inflammable materials used for liquefying; and that it actually will and has over a sufficient term of years preserved belts and permitted them to be run slack under full loads. Photographs of treated belts with letters giving full data from reliable firms offer desirable proof of the value of any manufactured belt preparation.

Simple tests to determine some of the objectionable ingredients can be made as follows:

Naphtha, gasoline, petrol, etc. A small amount of the preparation, if poured on a tin box cover and heated to 80° F., will ignite if any of these are present; also, if put in a loosely corked bottle and warmed, will lift the cork.

Gummy oils, varnish, gums, etc. These are easily detected by placing a small amount of the preparation on a flat tin and placing for a few days on a hot radiator or steam pipe. Any change in character, as to stickiness, drying out, or the leaving of gummy film or crust, is about the same as would take place on belting, and is of course harmful.

Soap. Solid substances used on belts are often based upon soap, rosin or some other gum. If soap is present, a piece of the substance (about the size of a nut) placed in a glass of water and allowed to stand for several days will soften, dissolve somewhat and give the water a cloudy appearance.

Before applying any substance at all to belting it is well to put a little on a clean piece of leather, place on an engine steam chest or on a hot radiator and then note the degree and time of penetration and whether the surface is left sticky.

Comparative testing of belt preparations

Some men thoughtlessly attempt to test Cling-Surface upon the same belt as has been used in trying another preparation. Frequently an old belt is used, or one which slips, or one on which almost everything has been tried. Such a test is no test at all as previous treatment may have vital influence upon the result.

Two belts should be taken *from the same roll*, one thoroughly filled with Cling-Surface and the other treated with the other preparation as directed by the manufacturer. The belts should be put to similar work and the number of times each requires any attention should be noted. Inclined or horizontal belts with under-pull offer the best demonstration as they may be slackened more to get the full benefit of increased pulley contact.

Careful record should also be kept of slip as measured by speed indicators, for there is apt to be more slip on an improperly treated belt than most people imagine. The belts being tested should be examined quite regularly and the Cling-Surface or other preparation re-applied, as the labels direct.

By following these suggestions a comparative test can be made which will be a real comparison and will be of real value.

Why coverings on metal pulley faces are not desirable

The use of coverings, paint, etc., on the pulley face is necessarily based upon the theory that the polished pulley face, and not the belt, is the element at fault in cases of belt slippage. This hypothesis we believe to be wrong for numerous reasons.

A pulley covering is intended to produce greater efficiency by increasing the frictional quality of the pulley face, which latter is accomplished by roughening that face. Any pulley covering that is in the slightest degree rougher than the polished metal raises the belt up on the highest points of the rough surface, thereby *decreasing the area of contact* between belt surface and pulley surface, and thereby increasing the tendency to slip by a corresponding amount. The tendency at peak loads is thus toward *de*creased instead of *in*creased transmitting capacity.

No material with which it is possible to coat a pulley will *absolutely* prevent *all* slip at *all* times When slipping therefore does occur, necessarily a higher degree of heat is developed between the belt and the rough pulley face than is possible between the belt and a polished pulley face, with possibility of increased injury to the belt in consequence, while on the other hand *absolute* prevention of slip at all times may not be desirable.

Under starting torque or sudden imposition of heavy load a slight momentary slipping is essential to permit the belt to assume its load gradually as it should. You know that if a street car motorman tried to get his car up to full speed from rest by throwing the controller through all notches at once, the passengers and mechanism would get a severe jolt and the motor if unprotected by a fuse would burn out. Similarly, slight momentary belt slip performs the same safety function as the fuse and does so automatically to prevent sudden destructive strains. Granting then that a pulley covering could prevent slip completely under extreme conditions, there would be nothing gained.

Pulley coverings rarely retain uniformity of face which they have at the start, and the growing irregularity continues to decrease belt contact and belt efficiency. As the glue or cement with which the covering is held dries out, becomes brittle and cracks, the intimate pulley contact is disturbed and slippage is aggravated. Furthermore, the dependence on pulley coverings alone for increasing belt efficiency does nothing to preserve the belt fabric and keep it pliable. Efforts to produce perfect belt efficiency through manipulation of the pulley face do not offer the proper solution, and tend to aggravate rather than stop the trouble.

On the other hand, proper belt treatment as herein recommended *does* entirely eliminate the trouble and does so without considering the pulley face in any way whatever. It may be noted that all photographs in this book portray belts running on polished pulley faces, and that in every case undesirable slip is so thoroughly eliminated that the belts can pull full load while running slack and are in perfect condition and health.

Supplementary Index

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Cling-Surface treatment is, we believe, the only system which is universally depended upon for perfect belt service

Steadily earning its way from one country to another during the past eighteen years, Cling-Surface has become known and valued throughout the world, and is now used as much abroad as at home.

Well-established business, which can only result from genuine merit, in almost all foreign manufacturing countries, has necessitated registry of the name Cling-Surface and our trade-marks in the patent offices of such countries, among which are:

United States	Germany	Norway	Java	Peru
Canada	Austria	Belgium	Japan	Ecuador
Great Britain	Hungary	Holland	Australia	Mexico
Spain	Russia	India	Argentine	Cuba
France	Italy	New Zealand	Brazil	Philippines
	Sweden	Ceylon	Chile	

As further evidence of universal use at home and abroad, Cling-Surface can be obtained at any time, either from our own stocks in warehouses or from our agents' stocks in any of the following cities:

New York	39-41 Cortlandt Street	Atlanta	Warehouses
Boston	170 Summer Street	Denver	
Philadelphia	520 Arch Street	Toronto	
Chicago	565 W. Washington Blvd.	Washington	
St. Louis	915 Security Building	Cincinnati	
Minneapolis	202 First Avenue South		

Also in San Francisco, Los Angeles, Seattle, Spokane, Portland, Tacoma, Butte, Reno, Albuquerque, Houston, Dallas, San Antonio, El Paso, Phoenix, Tucson, Salt Lake City, Winnipeg, Calgary, Edmonton, Nelson, etc., etc.

Abroad in

London	119-125 Finsbury Pavement	Calcutta	12 Mission Row
Glasgow	95 Bath Street	Sydney	85 Clarence Street
Paris	27, Rue Eugène Varlin	Auckland	(New Zealand) 58 Queen St.
Lille	229, Rue Solférino	Johannesburg	24 Chorton Chamber
Düsseldorf	Stromstrasse 3	Manila	105 Escolta
Madrid	Fuencarral, 134	Buenos Aires	562-566 Calle Moreno
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Bruxelles	55, Quai au Foin	Havana	51 Cuba Street
Rotterdam	Boompjes, 82	Kingston	72½ Harbour Street

Also in Gothenburg, Kieff, Colombo, Mexico, Chihuahua, Guadalajara, Monterey, Puebla, San Luis Potosi, Vera Cruz, Honolulu, Port of Spain, Tokio, Valparaiso, Singapore, Bandoeng (Java), Buluwayo (Rhodesia), etc., etc.

Cling-Surface is on the Official Approval Lists of the British Government, the British Navy and Army Lists and the Government of India—an unusual recommendation for a foreign product

Our Guarantee

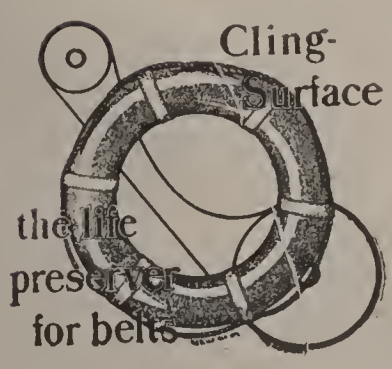
We guarantee that Cling-Surface treatment, used in accordance with our directions, will make and keep leather, cotton and hair belts and all ropes pliable, elastic, waterproof, and preserved; that properly used it will not harm good rubber or balata belts and that it will stop slipping of all belts and ropes so that the belts or ropes can be run easy or slack under full loads and with increased transmission capacity.

We further guarantee Cling-Surface to contain no rosin or other harmful products.

If after a fair test in connection with one or more belts or ropes, the results of Cling-Surface treatment are not in accordance with the above statements, any Cling-Surface purchased in the United States or Canada from us for such test may be returned within 60 days without payment for the Cling-Surface used or that returned or for freight either way.

If any difficulty whatever is experienced or Cling-Surface does not seem in every way to be what we claim, we ask only a fair chance to make good. Tell us the conditions explicitly; we are both looking for success and the Cling-Surface Company wants no money unless the customer is satisfied.

Cling-Surface Company



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